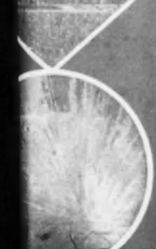
CHEMISTRY

PTEMBER
1961



irty-fifth
Year

New Atomic Base

50¢

A SCIENCE SERVICE PUBLICATION

Science Exhibits

➤ DOING is the key word in education through science. By doing their own experiments, students escape the sterile routine that comes from mere repetition of the great words of the past. They come into contact with the real world around them. Science has to do with the properties of matter, the behavior of living creatures, the concrete phenomena of the world.

Students of science attack the problem of understanding the world by learning about some particular section of it. They collect materials, they try experiments, they exchange information with others working in related fields. The true science teacher will build the course around the laboratory desk, so the student may learn through his own senses.

Having mastered some part of the world around him, the student's next impulse is to tell somebody about it. The effort of building an exhibit leads him to clarify his thought. This discipline has far more meaning for the student than merely "reading up" on the subject of his choice.

Recognition of students' accomplishments comes through competition in local science fairs and the National Science Fair. Interest in science is stimulated. Many sections of the community are often drawn together in the new planes of interest. Professional opportunities are opened for promising youngsters whose horizons may have been too limited.

* * * *

This editorial is taken from the preface to the book "Science Exhibits" edited by Helen Miles Davis. If you want information on how to select material, on how to plan its presentation, on how to display, on how to label your exhibit, on how to light your exhibit and how to describe the work you have done, send $2.00 for this book to CHEMISTRY, 1719 N Street, N.W., Washington 6, D. C.

CHEMISTRY

Vol. 35, No. 1 | Formerly Chemistry Leaflet | September, 1961

Including The Science Leaflet

Published monthly, September through April, by Science Service, Inc., the non-profit institution for the popularization of science. Publication Office: 326 W. Beaver Ave., State College, Pa. Second class postage paid at State College, Pa., and at additional mailing offices. Address subscription and editorial communications to the Editorial Office: 1719 N Street N.W., Washington 6, D. C.

$4 a Year; Two-Year Subscriptions $7; Your Own and a Gift Subscription $7 a Year. 50¢ a Copy. Ten or more subscriptions to the same address: $2.90 a Year each. No charge for Foreign or Canadian Postage.

Editor: WATSON DAVIS Assistant Editor: BURRELL WOOD

Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

Editor in Memoriam: HELEN MILES DAVIS (1944-1957)

IUPAC Congress

Elements Based on Carbon 12

The 18th International Congress of Pure and Applied Chemistry met in Montreal, Canada, August 6 to 12, 1961. The following are reports of some of the outstanding papers and actions of this meeting under the auspices of the International Union of Pure and Applied Chemistry.

➤ A NEW standard for the weight of all the building blocks of the universe, the chemical elements, has been settled after some years of bitter controversy with the selection of carbon atom weight 12.

All of the 103 known elements will be refigured, but the differences in the familiar periodic tables on schoolroom walls and in scientific books will not be apparent until the second decimal place in any case.

Oxygen atom 16 is dethroned as the standard. In fact, two oxygen standards are displaced. The chemists have in the past taken natural oxygen as 16 and the physicists have taken the isotope of oxygen 16 as bases. As there are three kinds of oxygen, isotopes 16, 17, and 18, in the natural oxygen in the air, there was a difference. Oxygen is now 15 followed by decimal 9994 with plus or minus one in the fourth decimal place.

The Council of the International Union of Pure and Applied Chemistry meeting here announced that they had joined the action of the equivalent union in physics taken previously on the carbon-12 base. There had been strong feeling for and against the change, not on national lines but depending upon the fields of science.

The international chemical body, with representation from all parts of the world, Communist as well, also straightened out nomenclature in thermodynamics so that formulas will be written the same the world over.

The standardization accomplished recalls that British, Canadian and U.S. scientists two years ago agreed on using the same length for the inch, which was equated to 2.54 centimeters. It changed the U.S. inch by four parts in a million, a matter of about six inches in the distance from Washington to New York.

The U.S. representative in the work on adoption of the carbon-12 standard was Dr. Edward Wichers, associate director of the National Bureau of Standards. Dr. A. W. Noyes of the University of Rochester, Rochester, N.Y., who is president of the International Union of Pure and Applied Chemistry, was also influential in adoption of the new standard.

Electricity Added Gives Super-Hot Gas Flame

➤ EVERY KIND of material known, including resistant substances like quartz and tantalum, can be melted with a new method of high-temperature production that combines combustion flames with electrical discharges.

The electrical voltage pumped into the burning flame doubles the heat that combustion alone can develop. Chemists forsee that the new high-temperature technique will find wide usefulness in metallurgical processes and allow more effective production of aluminum, steel and pure iron. It will beef up the open hearth steel process.

Its inventor, Dr. B. Karlovitz of Combustion and Explosives Research of Pittsburgh, described the process to the 18th International Congress of Pure and Applied Chemistry here. He predicts that his work will allow gas to compete with electricity in the production of industrial temperature ranges of about 4,000 degrees to 9,000 degrees Fahrenheit (2,000 to 5,000 degrees Kelvin). In recent years electricity has displaced gas in high-temperature production, and now the tables will be turned.

The kind of flame necessary to the job to be done, rich reducing for pulling oxygen out of the oxide ores of metals hard to separate, can be obtained as desired. Or conversely the flame can be made to add oxygen. High electrical voltage is not needed and the electrodes that feed the current into the fire are not in the heat of the furnace. The gas flame is conductive of the electrical discharge and spreads out the electrical power broadly into the furnace.

If desired, the flames can be made slowly radiant or they can be jets that are highly concentrated with high velocity. The flames can be shaped to fit a special need.

Dr. Karlovitz had the cooperation of Arthur D. Little, Inc., Cambridge, Mass., in the fundamental experimental study of flames that led to the materialization of the new process.

Half the energy of the furnace can be supplied by the electricity, and this addition gives the temperatures so much higher than the gas combustion alone.

Tantalum Carbide Used For Bright Lights

➤ By using tantalum carbide instead of tungsten in electric lamp filaments, a bulb that gives one-half again as much light and lasts up to twice as long has been produced.

Research on the new high brilliancy lamps was reported here to the International Congress of Pure and Applied Chemistry by two scientists from Polaroid Corporation, Cambridge, Mass., Dexter P. Cooper Jr. and George R. Bird. Although not yet manufactured, the new lamps are expected to be particularly useful in projectors for slides and films because the screen brightness depends on the actual brightness of the filament's surface.

The new tantalum carbide filament burns at a temperature of about 6,000 degrees Fahrenheit, whereas ordinary projector lamps burn at about 5,500 degrees Fahrenheit. The new lamps burn 24 hours, it is claimed, compared with 10 to 12 hours of presently used lamps.

One of the problems in the perfection of the new lamp was to find an atmosphere that would allow tantalum carbide to be heated to high tem-

peratures and remain stable. The inert nitrogen-argon atmosphere used in tungsten lamps was not satisfactory. Suitable gaseous atmospheres consisting of hydrocarbons and hydrogen were devised.

Sun Flare Induces Radioactivity In Satellite

➤ FROM A piece of lead exposed to solar radiation consisting of protons, during the flight of a recent satellite, Discoverer XVII, it was possible to determine the number of protons striking the lead, and their distribution in energy. About 100 million protons struck each square centimeter of the lead during the two day flight, it was reported by J. E. Keith, A. Turkevich, and G. W. Reed, University of Chicago and Argonne National Laboratory.

When on November 12, 1960, Discovrer XVII was launched into polar orbit from Vandenberg Air Force Base, California, a major solar flare was in progress, and the earth was being bombarded by enormous numbers of solar protons. When it was recovered over the Pacific Ocean, some of the material of which the satellite was constructed had been made radioactive by this bombardment.

A piece of lead sheet that had been part of a counterweight, about a quarter of an inch thick, had been in the nose of the satellite and was covered with a somewhat greater thickness of aluminum and protective materials. The variation of the bismuth-205 activity produced in the lead was examined as a function of the depth in the lead, hoping to be able to deduce from this the spectra of the solar protons.

Thin layers of the lead sheet, were machined off, and dissolved. The bismuth was separated from the lead and the bismuth-205, an unstable bismuth isotope with a 15-day half-life, was counted with an x-ray-gamma coincidence scintillation spectrometer.

Materials Resistant to High Temperatures Sought

➤ BECAUSE MAN is reaching for space and eventually to the stars, extremely high temperatures were discussed at the International Congress of Pure and Applied Chemistry.

The search for new materials is directed to substances that will withstand both the extreme heat of rocket travel and the sub-icy cold of empty space, as well as the rigors of temperature in nuclear reactors and plasmas generated in attempts to harness the thermonuclear H-bomb for power. The high temperatures of most interest extend from about 3,700 degrees Fahrenheit to hundreds of thousands of degrees — the lowest range of which is far above where steel glows white hot.

The existence of complex gaseous compounds that are not analogous to those in solids or liquids has been demonstrated. Usually compounds decompose into simpler molecules at high temperatures, but some gases contain three kinds of atoms instead of the usual two of most chemical systems.

Plasmajet Give High Temperature for Research

➤ Super temperatures of 20,000° Fahrenheit generated by plasmajet are aiding man's conquest of outer space, was told the 18th International Congress of Pure and Applied Chemistry, by Dr. Richard H. Tourin, manager, research laboratory, The Warner & Swasey Co., Flushing, N.Y.

A plasmajet is a stream of gas heated to about 20,000° F. by passing it through an electric arc. It is used to cut metal, to manufacture chemicals at very high speeds, and to reach high temperatures for use in laboratory studies.

By using the plasmajet, scientists simulate in the laboratory the very high temperatures produced by friction of the air against the surface of a space vehicle entering the earth's atmosphere. By measuring the heat radiated from a plasmajet to a solid object, scientists can find out if materials are sufficiently heat-resistant for use in building satellites and space vehicles.

Dr. Tourin reported on his work in measuring the radiation a plasmajet gives off. Some of this radiation is visible; the invisible ultraviolet and infrared portions were detected by sensitive instruments.

The amount of radiation depends on the plasmajet temperature and the number of gas particles. By varying the kinds of gas used, he was able to vary the amount of heat radiated.

The measurements reported by Dr. Tourin are useful for identifying chemical species in a plasma, in the study of energy transfer in plasmas, and for determining plasma temperatures.

Basic research into the nature of plasmas is necessary in order to utilize plasmajets in practical applications.

High Heats Help Make Better Fuels and Rockets

➤ By working with materials at temperatures ranging from 1800 to 7200 degrees Fahrenheit, scientists are finding how to make better fuels and rockets, and they are learning how the earth was formed, Dr. D. R. Lovejoy, National Research Council, Ottawa, told the 18th International Congress of Pure and Applied Chemistry.

At these high heats, scientists measure temperature either by color or by brightness as hot objects radiate heat and light.

First, objects glow a dull red, then at 1800 degrees they become brighter and orange in color, and still hotter they become still brighter and change first to yellow then to white hot.

The most important high temperature thermometer is called a disappearing filament optical pyrometer that measures temperatures by brightness changes. If the object cannot be seen, then scientists use a thermocouple.

At 1800 degrees Fahrenheit most familiar materials have melted and special pottery-like materials or hard-to-melt metals like platinum are used to build furnaces. At the highest temperatures above 7200 degrees, all materials have disintegrated into their

atoms and there is then no such thing as chemistry.

Scientists are becoming increasingly interested in this high temperature range from 1800 to 7200 degrees Fahrenheit. Chemists want to understand chemical reactions. This may in turn lead to better fuels for jet engines and rockets, new means of refining ores to obtain metals, new means of "fixing" the nitrogen in the atmosphere for fertilizers, and the discovery of new ways to synthesize chemical raw materials for the plastics and chemical industry. Physicists are interested in the strength of materials and the ways in which heat and electricity are conducted. This in turn will lead to better furnaces, rockets, jet engines, atomic power stations and so on. Finally, geologists are extremely interested in the chemical and physical properties of rock-like materials called silicates. This is the key to understanding what goes on deep inside the Earth, how the Earth and planets were formed, and where to look for valuable minerals. All these studies need a way to measure very high temperatures accurately and reliably.

Chemical Gun Heats Gases to High Temperatures

➤ A KIND of chemical gun that heats gases a few thousand degrees for several millionths of a second is being used to reveal the scerets of chemical processes, Dr. Doyle Britton, University of Minnesota, Minneapolis, Minn., reported to the 18th International Congress of Pure and Applied Chemistry.

In their shock tube gun, Prof. Britton and co-author M. van Thiel, use a slug of rapidly expanding high pressure gas as the bullet to push on some other gas at lower pressure.

This low pressure gas is compressed and heated a few degrees or a few thousand degrees depending on how hard it is pushed.

This compression and heating takes place in about a millionth of a second and will remain heated for several thousand millionths of a second before the walls of the shock tube cool it.

The researchers observe chemical reactions taking place in the shock tube, by looking at the amount of light being absorbed by the gas in the tube. From the changes in the light absorption, Prof. Britton can follow the changes in the amount of gas.

This experimental method allows the researchers to study chemical processes at temperatures not conveniently available by other methods.

In their work, they are studying the behavior of chlorine molecules as part of a series of studies on the chemically similar elements iodine and bromide. Their shock tube experiments allow them to work with only one or two of these simple reactions at a time, and therefore provides a starting point for the understanding of the more complicated reactions.

Grow Artifically Minerals In Crust of Earth

➤ CHEMISTS WITH special high temperature pressure cookers are artifically growing the minerals which make

up the earth's crust, reported Dr. A. C. Turnock, Carnegie Institution of Washington, Washington, D. C., in a paper co-authored by H. P. Eugster and D. R. Wones, told of their search to find how the earth's crust was formed.

"It is like looking for the recipe of a cake, by trial cookings of different mixtures at different temperatures and for different lengths of times," the chemists reported.

The researchers use a high pressure vessel with total steam pressure of 30,000 lb. per sq. inch, a thousand times greater than that inside a housewife's pressure cooker. Heats range from 900 to 1600 degrees Fahrenheit.

They have discovered a new method to grow the difficult iron silicates which make up a large part of the earth's crust. First they mix iron oxide, silicon oxide, and alumina in correct proportions, add water and seal it in a metal container. This container is placed in the pressure cooker where the steam and pressure finish the cooking.

For each mineral and for each group of minerals, they seek to find out how it grew, its chemical composition, the pressure and temperature. The answers to these questions should tell the conditions under which the crust of the earth was formed.

Gravity Defied to Give Molten Sphere of Metal

➤ Levitation is the gravity-defying technique now being used by scientists to freely suspend small masses of liquid metal in space. Dr. Alex E. Jenkins, associate professor in metallurgy, The University of New South Wales, Sydney, Australia, reported to the 18th International Congress of Pure and Applied Chemistry that scientists use this technique to melt and cast small quantities of highly reactive metals.

To beat gravity by the technique of levitation, a cone-shaped silver or copper coil is used. Metal is placed in the space formed by the coil and an A.C. electric current is applied to the coil. The metal melts, rises, and hovers as a molten sphere.

Prof. Jenkins reported a new advance in the technique. In the past, it had not been possible to accurately control, or measure the temperature of the liquid metal. His group has overcome this problem by using differently shaped levitation coils coupled with a cooling atmosphere of helium gas. Conditions are so stable that the fiery metal ball can be photographed as it spins rapidly in a way similar to the earth on its polar axis.

Highly reactive metals can be studied by suspending them in ordinary glass test tubes. In this way, the metal alone is subjected to the attack of gases or even other liquids which can be spun around the liquid sphere like candy around an apple.

Atomic Absorption Spectroscopy Used in Analysis of Metals

➤ The ability of an atom to become excited is now being applied in a new and useful analytical technique in medicine, agriculture and industry, Dr. J. W. Robinson, Esso Research Laboratories, Baton Rouge, Louisiana, told the 18th International

Congress of Pure and Applied Chemistry.

Atoms are made up of electrons rotating in orbits around a nucleus. When the electron is in the orbit closest to the nucleus, it is unexcited; if in higher orbits it is excited. Usually excited atoms shoot off radiant energy and become unexcited in less than a millionth of a second.

If the wavelength is correct, unexcited atoms will take up light rays and become excited. This ability of atoms to absorb light at certain frequencies forms the basis of a new way to detect and measure small quantities of these atoms. This technique described by Dr. Robinson is called atomic absorption spectroscopy.

Already these analytical procedures can measure metals in concentrations as low as fractional parts per million.

In the medical field, it has been used to analyze body tissue and fluids thus helping us understand body functions. The numerous applications in industry include determining the purity of gold, platinum, and fine chemicals. By analyzing samples at different stages of manufacture, it gives chemists a better understanding of manufacturing processes.

Although it was once believed that intense heating was the only way to excite an atom, scientists now think it can be caused by other forms of energy such as light and by chemical reaction.

Atomic absorption spectroscopy involves spraying a solution containing a metal into a flame and passing light from a special lamp through the flame. The metal strongly absorbs certain wavelengths of this light. These wavelengths are characteristic of the metal, and so the kind of metal and its quantity can be detected.

Two New Graphite Compounds Discovered

➤ Two NEW compounds of graphite were reported by Dr. J. G. Hooley, University of British Columbia, Vancouver, to the 18th International Congress of Pure and Applied Chemistry.

Graphite and diamond are the two forms of solid carbon. Graphite is made up of sheets of carbon atoms laid on top of each other. The forces holding the sheets together are weak, but within each sheet they are strong. It is as if each sheet were a large, flat molecule whose boundaries were the edges of the graphite crystal.

Prof. Hooley described his work in separating these sheets of carbon atoms by exposing them to chemicals. These chemicals separate the sheets to about twice their normal separation and remain between the sheets.

By increasing the vapor around the crystal, varying amounts of chemical enters. Prof. Hooley prepared in this way two new compounds with the formulae $C_8I\,Cl$ and $C_{16}I\,Cl$, and he proposed a new theory on why this works. He measured the amounts of chemicals by a special all-glass recording vacuum balance.

This research adds to scientists' knowledge of graphite, a material of much importance in nuclear reactors, dry lubricants, corrosion-resistant chemical equipment, electrodes, etc.

Sun Furnace Used In Silica Study

➤ THE SUN'S RAYS proved better than any man-made furnace to produce the intense temperatures needed in the experiments on silica reported by Dr. V. V. Dadape, University of Wisconsin, Madison, at the 18th International Congress of Pure and Applied Chemistry.

Prof. Dadape and co-worker J. L. Margrave built a solar furnace to trap the sun's rays. They obtained temperatures up to 5400 degrees Fahrenheit, almost instantaneously after the start of heating.

The mirror of the solar furnace concentrated the intense heat of the sun's rays into a one-third inch diameter area. Temperatures of 5400 degrees F. were obtained within 15 to 30 seconds of the start of heating.

The researchers preferred the solar furnace because it gave a pure heat, free from the electric and magnetic effects of man-made furnaces. The solar furnace was used in vaporizing various oxides of silicon.

Analysis Iron-Steel Gases Radioactivity

➤ MORE convenient and reliable analysis of gases in iron and steel is promised by using radioactive isotopes, C. R. Masson, National Research Council, Halifax, N. S., told the 18th International Congress of Pure and Applied Chemistry.

The advantage of the method of Dr. Masson and his co-author M. L. Pearce, is that the complete isolation of the nitrogen to be analyzed is not required, as in conventional methods.

Steel chemists need to know how much nitrogen and other gases are present in steel as even small quantities can cause case hardening or surface hardening of gears, bearings, etc.

In the isotope-dilution method, the metal is melted in the presence of a small amount of the isotope nitrogen-15. This releases the nitrogen-14 already in the steel, and the two gases mix. The amount of nitrogen released from the steel is easily estimated by measuring the ratio of the two isotopes at the end of the experiment.

The chemists determine the ratio of the two isotopes by using a mass spectrometer. This instrument works on the principle that, when a small quantity of ionized gas is allowed to stream between the poles of a magnet, the lighter ions are deflected in the magnetic field more than the heavier ones. In this way, the relative amounts of the two isotopes nitrogen-14 and nitrogen-15 (the atoms of which differ by one mass unit) are estimated.

Cellulose and Polymers Give Paper Improvements

➤ THE MARRIAGE of cellulose from trees with man-made polymers like rubber may lead to major improvements in paper, rayon and cellulose film.

Dr. J. J. Hermans, State University College of Forestry, Syracuse, N.Y., told the International Congress of Pure and Applied Chemistry that chemists are now grafting synthetic polymers onto cellulose to make tailor-made paper, rayon, transparent

cellulose film and a whole variety of new products.

The strength of paper can be increased considerably by grafting. However, the future applications may be in special purpose paper, rayon or cellulose film. The marriage with man-made polymers may give products that react differently to various chemicals including printing ink and other dyes, swell less in water, and possibly be more fire proof.

Elements In Nuclear Reactors Studied

➤ A BETTER knowledge of the palladium-group metals is helping chemists to understand the behavior of elements made in nuclear reactors, Dr. W. E. Bell, General Atomic Division of General Dynamics Corp., San Diego, California reported at the 18th International Congress of Pure and Applied Chemistry.

Dr. Bell, and co-workers Ulrich Merten, K. Tagami and M. C. Garrison, told of work done under a U. S. Atomic Energy Commission contract on the high temperature chemistry of the transition-metal elements, ruthenium, rhodium and palladium.

An understanding of the behavior of fission-product metals often requires a knowledge of the behavior of transition-metal elements. The fission-product elements, some of which are highly radioactive, are a constant source of trouble. They poison the fission reaction, contaminate the reactor, cause radiation damage and ultimately must be separated from the uranium remaining in spent nuclear fuel.

Very little is known about the high-temperature chemistry of the transition-metal elements. This lack of knowledge is becoming more obvious as chemists get into high-temperature processing methods and face problems of estimating the stability of chemical species at high temperature.

When their work is done, Dr. Bell and his group hope to correlate their data with other data on these elements to find out how their high-temperature chemistry varies. Such correlations will aid in predicting the behavior of species for which data are not available.

Crab-like Molecules Separate Niobium and Tantalum

➤ SPECIAL molecules which use their crab-like pair of claws to capture atoms of other molecules are now being used to separate the twin elements niobium and tantalum.

Dr. A. K. Majumdar, Jadavpur University, Calcutta, India, reported at the 18th International Congress of Pure and Applied Chemistry that these twins always live together in the earth's crust and until recently, had resisted all attempts to separate them. Prof. Majumdar used certain organic chemicals, called chelating ligands, in a new method to easily separate the twins in a pure state. A molecule of the chelating ligand has two active and aggressive "tentacles" which can hold to the metal atom as if by two claws.

The ligands used by Prof. Majumdar were derived from hydroxylamine. Using them, the complete separation and estimation can be finished in one

hour. Previous methods were tedious, or gave imperfect separation of the twins.

Tantalum is used in electrolytic rectifiers for producing direct current, in corrosion-resistant chemical plant equipment, in making tools for high-speed machining of metals, in electrodes for neon signs, in fine jewelry with iridescent colors, in dental and surgical instruments, and in surgery for joining broken limbs.

Niobium is used in chromium steels to make them more weldable, and in heat resistant steels.

The close association of the twin metals bluffed chemists for 40 years into thinking they were one and the same. The name tantalum is suggestive of frustration in its recovery. In Greek mythology, Tantalus was sent to Hell where he was doomed to stand for ever thirsty up to his chin in a cool lake. Whenever he bent to drink, the water disappeared. Their close relationship is indicated by the name niobium, after Niobe, the tragic daughter of Tantalus.

New Valuable By-Products From Kraft Pulping

➤ New by-products from the kraft pulping process are now being discovered that may be valuable as solvents, plastics, or in medicine. Dr. Terje Enkvist, University of Helsingfors, Finland, in a technical paper, described how the sulphur formed in kraft pulping reacts with the lignin of the wood to form chemicals. Several of these are in the kraft waste liquor and will perhaps in future be found to have valuable properties.

Heating the waste kraft liquor with sodium sulphide at high temperatures and pressures can also be used to produce solvents, plastics and other useful products.

The kraft pulping process is used to a growing extent in all pulp-producing countries. One drawback is evil-smelling sulphur compounds it produces. Prof. Enkvist's paper reported several years work on seeking the role of sulphur in kraft pulping.

Fluorescent Light Shows Food Poisons are Present

➤ Some poisons sprayed on foods to combat insect pests can be made to signal their danger by the light they give off when flooded with ultraviolet radiation.

The International Congress of Pure and Applied Chemistry here was told by Dr. D. MacDougall of the Chemarga Corporation of Kansas City that fluorescence measurements have higher sensitivity than other methods, but can be applied only when the chemical itself is fluorescent or can be made to produce a compound that has this effect.

Increasing stringency of control regulations of many governments has caused chemists to search for new and better analytical methods for detecting the residues of pesticides left in food.

Produce Tungsten In New Commercial Way

➤ A new way of producing tungsten that may prove commercially feasible, was described by Dr. A. W. Henderson, extractive metallurgist, U. S. Bureau of Mines, Albany, Oregon.

In the new process, the tungsten-bearing mineral scheelite reacts with chlorine gas at temperatures from 500° to 700° C. with either carbon or gaseous sulphur dioxide present.

Similar commercial chlorination techniques were first used a few years ago to recover the rarer metals such as titanium, zirconium, columbium and tantalum.

Chlorination has not been applied to other metals such as tungsten perhaps because of the success of more conventional methods. Tungsten is usually made by treating the ore with hydrogen, aluminum or carbon and sintering the product.

Tungsten is used for filaments in lights, targets in X-ray tubes, electrical contacts, cutting tools and as an alloy tor steel.

Radioactive Device Detects Pesticide

➤ USING A special radioactive detector, scientists can now quickly identify as little as one-ten millionth of a gram of pesticide, Dr. J. G. Reynolds, Shell Agricultural Research Centre, Sittingbourne, England, declared in a paper at the 18th Congress of Pure and Applied Chemistry.

Dr. Reynolds and his co-author, Dr. K. E. Elgar, applied this new detector to the analytical tool of gas liquid chromatography in the analysis from crops, soil and biological tissue for traces of chlorinated pesticides.

Their novel detector has a radioactive source of electrons which are absorbed by the chlorinated pesticides much more than they are by other types of compounds extracted from the sprayed crops. So their detector "sees" the halogenated pesticide and ignores the other extractives.

Advantages of this new technique, called electron capture detection, are that food analysis no longer need to separate the minute quantities of pesticide from the large amounts of material co-extracted from the treated crop. Now all they do is inject the extract into the apparatus, and identify the halogenated pesticide. In less than an hour they can get a good estimate of the trace concentration present.

Gas liquid chromatography is a separatory technique in which the extract from the treated crops or soil is introduced into a gas stream passing through a short tube containing adsorbents. The components of the extract are separated in their passage through the tube and are detected, one after another, as they emerge through the detector.

Insecticides Controlled to Increase Alfalfa Yields

➤ CHEMISTS AND entomologists working with potent insecticides are increasing the yield of alfalfa hay for farmers in southwestern Ontario, reported Chemist J. R. W. Miles, Entomology Laboratory, Canada Department of Agriculture, Chatham, Ontario, to the 18th International Congress of Pure and Applied Chemistry.

They do this by controlling the spittlebug, while at the same time keeping the hay safe to use for feed. After the spraying is done, the chemists make many chemical analyses to find out if enough insecticide was

used, if more should be applied, and if the amount of the insecticide residue is low enough to make the crop safe for use.

When these chemical analyses are compared to the number of spittlebugs killed by the different insecticides, the entomologists can choose, without guessing, the proper material to control the insects and keep the crop safe to use.

Since one pound of alfalfa might contain less than one-millionth of a pound of insecticide, chemists do much research in developing the best methods of analysis. Very precise analytical work is involved.

No Effect on Enzymes From Organophosphorous Insecticides

➤ ANY TRACES of organophosphorus pesticides that may be found in foods would have no measurable effect on enzymes in animals, Dr. W. P. McKinley, Food and Drug Directorate, Ottawa, reported at the 18th International Congress of Pure and Applied Chemistry.

Dr. McKinley with his co-author Sheila I. Reid, described their work on inhibiting rabbit liver esterases by these pesticides.

Esterases are a family of enzymes which take part in the reactions to convert food in the stomach or intestines into a form which can be absorbed in the blood stream. They are essential in the conversion of this digested food into energy or into new body tissue.

The action of some of these esterases is altered by some of the organic phosphorus pesticides. The chemists used this interference in their study to detect and identify any residues of these pesticides which might be present on foods as a result of misuse in application.

They were seeking to learn what effect these pesticides have on enzymes in tissue. They are studying the effect of minute traces of these pesticides on enzymes in the intact animal.

Extracts of heart, lungs, spleen, testis, liver, kidney, muscle and brain from rabbits and guinea pigs have been studied as well as extracts of mosquito larvae, house fly larvae, dew worms, and the livers of several types of salt water fish and each extract contains a different set of esterases. Twenty-two different organophosphorous pesticides have been tested with rabbit liver but only two with the other tissue.

Little Soil Insecticide Gets Into Crops Grown

➤ THE AMOUNT of insecticidal residues transferred from soils into most crops appears to be zero or very low under normal conditions, Dr. E. P. Lichtenstein, University of Wisconsin, Madison, Wisc. reported to the 18th International Congress of Pure and Applied Chemistry.

Insecticides applied directly to crops find their way to a large extent into the soil. To control soil insects, some of these chemicals are also incorporated into the soil. The resulting insecticidal residues persist over various periods of time, depending on the in-

secticide itself, the soil type and various biological and physical factors, such as micro-organisms, soil moisture and soil temperature. DDT is one of the most persistent insecticides and was recovered to an extent of 10-18% of the applied dosage, 10 years after treatment of turf plots. Other insecticides are considerably less persistent and disappear either through volatilization from the soil or through breakdown mechanisms within the soil. During recent years it was found that some insecticides within soils are converted to other compounds which also have insecticidal activities and in some cases are more persistent than the parent compound.

It is of primary importance to find out if and to what extent crops, grown in pesticide-containated soils are affected. Moreover, do pesticidal residues find their way into the edible parts of crops? Translocation of insecticides through the root system of plants has been established in experiments, where abnormally high concentrations of insecticides were used. Lindane is the insecticide most readily translocated and carrots grown in insecticide treated soil, contained more toxic residues than any other crop investigated.

In Prof. Lichtenstein's experiments high concentrations of five and 25 pounds of insecticide per acre were used and compared to normal sprayings of one and two pounds per acre. But even at these heavy sprays, onions, pea seeds and beans did not not contain any residue. The insecticidal residues found within potatoes were located primarily within the potato peelings.

The amount of insecticidal residues translocated from soils into the crop tissue is dependent on the particular crop, the insecticide and its concentration within the soil as well as the soil type. Under "normal" conditions the residue content within most crops appears to be zero or very low.

Make Insecticides Safe To Man and High Animals

➤ Attempts to tailor-make phosphorus-containing insecticides that are highly poisonous to insects but safe to man and higher animals, were described by Dr. R. D. O'Brien, associate professor, Cornell University, Ithaca, N.Y., at the 18th International Congress of Pure and Applied Chemistry.

In his work Prof. O'Brien is using two approaches: metabolic selectivity, and target selectivity.

Certain well-known safe insecticides such as malathion, dimethoate and Diazinon, are safe because they break down rapidly in mammals but slowly in insects. This is because these safe insecticides have a special chemical group called a "selectophore," which confers selective toxicity to insects, but not to mammals.

Dr. Bell's search has begun to uncover enzymic differences between insects and mammals and between different insect species, which can be used to design new kinds of selectophore.

His other studies are directed to discovering differences in the nature

of cholinesterase, the target enzyme vital to the nervous system, in insects and mammals, in order to obtain compounds which are better against the insect target than the mammalian target.

An examination of the effectiveness with which some agents interfere with the attack of insecticides upon isolated cholinesterases revealed such differences, and knowledge of the molecular forces which are needed for successful attack wes expanded.

Big Sugar Molecules Tell How Viruses Work

➤ FROM SIMPLE sugars, chemists are building large polysaccharide molecules which are helping them to find out how enzymes and viruses work, Dr. Peter T. Mora, National Institutes of Health, Bethesda, Md., reported to the 18th International Congress of Pure and Applied Chemistry.

These chemically synthesized polysaccharides were different from the natural ones such as starch and cellulose. These differences gave special properties that made the synthetics excellent model substances for studies in biochemistry and certain of their derivatives were used to find out how enzymes and viruses can be inhibited.

The polyanionic carboxyl derivatives inhibited basic enzymes which are the catalysts in life processes. These derivatives also killed certain bacterial viruses, such as the bacteriophages which are viruses that attack bacteria. Other synthetic derivatives of polysaccharides are being studied now for their biological action.

Solid Materials Not "Dead" At Low Temperature

➤ DESPITE appearances to the contrary, solid materials at very low temperatures are not chemically "dead," but can undergo chemical changes.

Dr. Michel Magat, professor, University of Paris, France at the 18th International Congress of Pure and Applied Chemistry, reviewed the present state of knowledge in this new field of chemistry, the study of organic reactions in solids at very low temperatures. Several laboratories in the United States, England, U.S.S.R., Japan, and France are actively working in this research.

For years chemists assumed that solids at low temperatures were chemically "dead" and no chemical reactions could occur. Since the early fifties, this picture has been shown to be too crude.

At low temperatures, strange things happen. At temperatures of liquid air (around minus 191° C.), the familiar preservative and disinfectant, formaldehyde, adds to itself as an explosive rate, while no explosions are seen at a higher temperature. At liquid air temperatures, if benzene is irradiated with ultraviolet light, its familiar 6-sided ring opens and tears apart a neighboring molecule and adds the fragments to its open ends.

Just what all this new chemistry will bring in the way of practical applications, is too early to foresee.

U. S. Residue Studies Aid World Pesticide Use

➤ RESIDUE STUDIES conducted in the

United States, which are the basis for federal and state regulations permitting longlasting pesticides like dieldrin and endrin on forage crops, eliminate the need for such studies in many other nations, the 18th International Congress of Pure and Applied Chemistry was told by Dr. Louis Lykken and Lewis Mitchell, of Shell Chemical Company, New York.

These extensive tests have proved "it is possible to treat forage crops at an early stage without danger of contaminating milk, meat or other dairy products because, during the normal weathering of the green crop in the field, the chemical residue sprayed onto the crop gradually disappears with time."

There is a tendency for regulatory people in various countries to insist that residue dissipation studies be conducted or repeated, in each country, the authors said. "This is often not practical, they averred, because no account is taken of the fact that the rate of disappearance of residues from a crop is, for all practical purposes, often the same for a number of geographical areas, because many countries have similar climatic conditions, and because the cost of conducting the necessary experimental programs is very high."

The method of testing insecticide residue dissipation is simple in principle, but it requires:

1. Careful application of the chemical to a large number of experimental plots.

2. Repeatedly taking a very large number of samples from the treated as well as untreated plots.

3. Analysis of the great number of samples (200-300 of them) by the use of very sensitive, time-consuming methods of chemical analysis.

This is a very expensive operation which may take two or three years to accomplish. In addition, it is necessary to make feeding studies to find out the amount of the chemical which can be in the total ration of cattle and other commercial animals, without leaving a significant amount of chemical residue in the milk and meat produced from them. This too, is a very expensive study because it requires the destruction of the animals used and entails the analysis of hundreds of tissue and milk samples.

Exhaustive tests of this nature extending over a two year period have been made in the United States involving the use of dieldrin and endrin on alfalfa, the paper reported. Plots of alfalfa in California, Louisiana, Missouri, and Ohio were treated with dieldrin and endrin spray when the alfalfa was four to eight inches high. Some 260 samples from the treated plots and nearby untreated were taken just before spraying, a day or two after spraying, and at approximately weekly intervals, up to 35 days, after spraying.

The apparent dieldrin or endrin residue content was determined by chemical methods that, by a large number of tests, have been shown to detect less than one part in 10,000,000 parts of crop sample.

It was found that the apparent resi-

due content of the alfalfa crops gradually disappeared as the length of time increased after spraying. The samples from the treated plot were considered to be free of chemical residue when the results obtained for the treated plot could not be distinguished from those obtained from the untreated plots. In no case did the residue content remain at a significant, detectable level for an indefinite period.

Spots On Paper Clues Wildlife Pesticides

➤ SPOTS ON A sheet of absorbent paper are the only clues needed by chemists to detect pesticide residues in wildlife, Dr. H. Eagen, Laboratory of the Government Chemist, London, uses this "spot" technique, known as paper chromatography, to measure small doses of the pesticides dieldrin, aldrin and heptochlor in pigeons and foxes which have ingested known doses of these materials. In this way, the researchers hope to find if there is hazard to wildlife from these pesticides.

Other workers earlier this year used the same analytical technique to show that many deaths of birds were due to eating seeds which had been dressed with these pesticides.

Paper chromatography separates minute quantities of different substances by running a solution of them down or up a sheet of absorbent paper. The different pesticides appear as "spots" on the paper. The position of each spot on the paper is a clue to the identity of the pesticide, and its area enables the chemist to calculate the amount.

Surface and Depth Of Alloy Different

➤ THE DISCOVERY of a significant difference between the composition of the surface of a dilute metallic alloy and the composition of the bulk of the material beneath the surface was by Dr. Joseph T. Kummer of Ford Motor Company's Scientific Laboratory.

This conceivably could have an effect on future technology in the fields of catalysis, adhesion and corrosion.

Metallic alloys long have been employed extensively as catalysts for various reactions, and these catalytic reactions take place exclusively at the surface of these solids. Traditional thought in this field has assumed heretofore that the surface composition of these solids does not differ from the composition of the material beneath the surface.

Dr. Kummer, produced evidence that there can be a substantial difference between the surface and the bulk in these materials. The Ford chemist's research represents one of the few studies directed exclusively toward determining whether such a difference does exist.

In his study, Dr. Kummer used high surface area samples of dilute copper-nickel alloys (99% Cu - 1% Ni), and exposed the surfaces to oxygen at dry ice temperature (—78.5 C.). This controlled surface oxidation produced an oxide layer approximately the equivalent of one monolayer, a layer roughly one atom in thickness. This monolayer then was removed by ethylene diamine, a chelating agent,

and analyzed for nickel content by conventional chemical procedures.

Chelation is a chemical phenomenon by which metal ions — electrically charged atomic particles — are sequestered, or segregated, by certain chemical compounds. Chelation is commonly used to soften water.

By analyzing the oxide monolayer, Dr. Kummer found that the surface was composed of 90 parts copper to 10 parts nickel, although the bulk retained its original composition of 99 parts copper to 1 part nickel.

This divergence from traditional assumptions about the composition of solids is an important factor to be considered in future fundamental studies of the structure and behavior of solid materials.

"I suppose, Dr. Argyle, this means you'll want an increase in your research budget!"

CBAC EVALUATION 1960-61

This is the fourth in a series of articles concerning the progress of this very interesting effort to organize an introductory course in chemistry around the concept of the chemical bond. This experiment in curriculum development is being financed by grants from the National Science Foundation to Earlham College in Richmond, Indiana. This article reports on the development of the Chemical Bond Approach Course during the school year 1960-61.

➤ THE CBA course has now been taught in schools for two years. Results of the first year's trial dictated many revisions in the second edition, although much of the material which was presumed difficult was found not too hard for the majority of students. Feedback from schools in the second year's trial program again suggests a number of changes which are necessary, but the general response has been that the bulk of the course is not only teachable but also stimulating to students.

Trial School Statistics

During the past school year there were seventy-five schools in the official evaluation program, seventy-six teachers, and at least 3,957 students. (Data given were compiled May 10 and were not complete in all areas at that time.) The average number of CBA students per school was fifty-two, but the range was from nine to 176. The number of sections taught by each teacher was as follows: one section—28, two sections—20, three sections—12, four sections—11, and five sections—5.

Grade levels 10-12 were represented. Class breakdown was as follows: 10th grade students only—7 classes, 11th grade only—13, 12th grade only—9, 10th and 11th together—1, 11th and 12th or 10th, 11th, and 12th combined—the remaining classes. Six sections included selected sophomores (selected on prior grades and test performance), eight selected juniors, and four selected seniors. One class was composed of second year chemistry students, and two classes were offered to students who cover the ordinary one-year course in two-years' time.

Thirty-four schools taught CBA chemistry to "average" students, seventeen to college preparatory students, and twenty only to those students with high academic ability. No school offered the course to selected low ability students.

There were six private schools, two university laboratory schools, and three parochial schools in the project.

Thirty schools had laboratory periods ranging from 42 to 55 minutes, eighteen had 60-minute periods, fifteen had 66-90 minute labs, and seven had lab periods ranging from 93 to 120 minutes. One school was able to schedule the laboratory all afternoon one day each week per class.

Laboratory Program Revision

As a result of an analysis of feedback from trial schools during the past year, the laboratory program will be revised in several ways for the third edition. Testing of various aspects of the program in the summer institutes may also result in further revision, but present plans are as follows:

(A) In the first part of the laboratory program, the number of experiments will be increased to give the teachers more selection. Most of the new experiments will present various laboratory techniques in a problem-solving situation.

(B) A new format will be used for presenting the experiments in the Student's Guide. For the beginning experiments, the presentation will include introductory information, a statement of the problem to be investigated, and an appropriate procedure.

(C) The experiments will be divided into three groups. Group I experiments will contain detailed and extensive information for the student. This information will be considerably reduced in amount for the Group II experiments. For those experiments in Group III, only a statement of the problem to be investigated will be given.

(D) The quantity of instructions given to the students will be reduced gradually. When a laboratory operation is first used, the instructions to the students will be specific. For additional use of this technique, the directions will be presented in less detail. In Group I experiments, a rather detailed description of the procedure to be followed will be given and a flow sheet presented, whereas for experiments in Group II only a minimum description or a flow sheet will appear.

(E) The appendix will contain sections on: (1) Suggested procedures for standard laboratory operations. (2) Questions relating to the majority of the experiments. (3) A discussion of errors. (4) A description of flow sheets. (5) A table of atomic weights.

Demonstrations

During the 1960-61 school year many teachers in the Project used demonstrations to introduce, illustrate, or apply points made in discussion of the text. Several teachers expressed concern that such demonstrations ought to fit smoothly into the text-lab pattern of the course. To insure this, R. D. Eddy of Tufts University has accepted the job of preparing, partly from teachers' suggestions, an appropriate group of lecture demonstrations to be published as a part of the CBA course materials. He has put to test some of these demonstrations in the institute at Tufts this summer.

Text and Laboratory Guides

A tentative third edition of the student's laboratory guide was prepared for use in the 1961 summer institutes. A collection of forty experiments will be the basis of the 1961-62 program in the schools. The second

edition of text materials will be reprinted, with a few minor alterations, for use in schools during 1961-62. The same edition will probably be used during 1962-63.

Work is currently underway to prepare copy for a third edition of the text, based on information obtained from the trial schools during the past year. Walter Hunter, Kenneth Borst, James DeRose, Elton Knutson, Robert Sheets, Paul Westmeyer, Earle Scott, Leallyn Clapp, Arthur Livermore, Kent Wilson, and Laurence Strong participated in a conference on CBA course revision. This was held from August 10 to August 22 at the University of Vermont. Several other persons attended for a few days at a time as consultants. Negotiations are also being made to select a publisher, and it is hoped that the third edition will be available through commercial channels in the spring of 1963. Concentrated efforts are being made to combine the third edition of the text and the fourth edition of the laboratory guide into an integrated whole.

CBA In Other Countries

The National Science Foundation has given the CBA Project a grant of \$15,525 for a subsidiary project entitled "Exploration of International Implications of Chemical Bond Approach Project." The intent of the grant is to supply materials and information about the course to people in other countries, and to explore the possibility of making use of a different educational setting for getting information about the possibilities the course might have. It is hoped that such information will be useful in furthering the development here in the United States.

Pakistan

Professor M. S. H. Siddiqi of the University of Peshawar has arranged for a summer institute to offer CBA materials to selected teachers in Pakistan. This institute is sponsored by the Asia Foundation. During the summer of 1960 Professor Siddiqi spent several weeks at the CBA institute at Kenyon College in Gambier, Ohio. He invited Professor Eric Graham of Kenyon to present the lectures in the Pakistan institute. Professor Graham was in Pakistan during July and August, 1961.

The CBA course is also being adapted by Professor Siddiqi for use in the colleges associated with the University of Peshawar. The materials will thus be used with college students as well as, it is hoped, with secondary students as a result of the institute.

Chile

An Escuela de Verano was held at the Instituto Pedagogico of the University of Chile, Santiago, Chile from January 9 to February 18, 1961 under the sponsorship of the University of Chile and the Organization of American States. Funds were furnished by the National Science Foundation to allow H. A. Neidig and Leallyn B. Clapp, directors of CBA, to join the staff at the University to teach CBA Chemistry to eighty-eight high school (a few taught in college) teachers. About seventy of the teachers were from Chile and the rest from Argentina, Bolivia, Brazil, Ecuador, Paraguay, and Peru.

Harold Behrens, Research Chemist in radio chemistry at the Centro de Quimica of the University of Chile,

was director of the summer institute. A group from the Instituto Pedagogico, Behrens himself, and some of his students and staff at the Centro de Quimica, had translated the CBA material into Spanish in about three months — a terrific job. Lectures given by Professor Clapp were translated by Dr. Behrens paragraph by paragraph and Professor Neidig's discussions in the lab were also translated, although at least one-fourth of the teachers understood without translation. Hour lectures were followed by small group discussions daily, and all the laboratory experiments were performed in groups of eight, since there was not enough room for individual desks in the laboratory.

During the institute, the participants completed sixteen of the CBA experiments. All sixteen experiments were well received by the participants. These included the "Black Box," "A Comparison of Sodium Chloride and Napthalene," and "Heat of Formation of Solid Ammonium Chloride." "The Thermal Decomposition of a Hydrate" stimulated the most discussion of any of the experiments.

One of the most dramatic points of the institute occurred when a group of secondary school students did the "Black Box" experiment. These were students directed by Professor Pedro Weissbrod, one of the participants from Argentina. After the students had completed their investigation of the sealed boxes in the laboratory, Professor Behrens conducted the post-laboratory discussion session with the institute participants as an audience. The students defended orally, with considerable enthusiasm, their written reports. Everyone was impressed by the logical, systematic way in which the students constructed a model to represent the object contained in the box. This demonstration served to illustrate vividly that students not only thoroughly enjoyed this type of experiment, but also were able to obtain useful information from their work.

At present, chemistry instruction in the schools of Chile is given over a three-year period in the last years of high school. The teaching load is heavy, and most high schools do not have laboratories. Thus the students' lab experience comes from observation of teacher demonstrations. As in many countries, students must take a school-leaving examination, and it is upon this examination that course content is largely determined.

Philippine Islands

Professor Arthur Livermore of Reed College, Portland, Oregon and Professor William Schmitt of the Ateneo de Manilia instructed an institute group of secondary school teachers in the Philippines in the content and philosophy of CBA from April 10 to May 19, 1961. This institute was sponsored by the Asia Foundation.

A Philippine chemistry teacher is confronted with three major restrictions:

(A) Most schools have no laboratories, so the experiments had to be done with improvised equipment and common chemicals. (Soda straws were used for the effusion experiment.)

(B) Present chemistry courses are largely technical, and few teachers have been trained in chemical theory.

(C) Most students in high school chemistry will take a civil service examination which contains such non-

CBA questions as "Give the flow sheet for the benificiation of bone china" and "What are the disadvantages of hard water in industry?"

In order to introduce theoretical chemistry into the secondary schools it is planned that the beginning courses at the Ateneo will be based on CBA for a time. Then, when enough teachers have been trained, these materials will be used in the high schools courses.

Ireland

From July 3 to July 28, 1961 Professor O. T. Benfey of Earlham College and Dr. Wendell Taylor of The Lawrenceville School, Lawrenceville, New Jersey presented some of the content and philosophy of CBA at an institute in Dublin, Ireland. This institute was sponsored by the Organization for European Development, an alliance of some eighteen European countries and the United States. It was attended by teachers and administrators from many of the member countries, with about 50% of the participants coming from Ireland. CHEMS materials was presented by Robert L. Tellefsen, Napa, California High School.

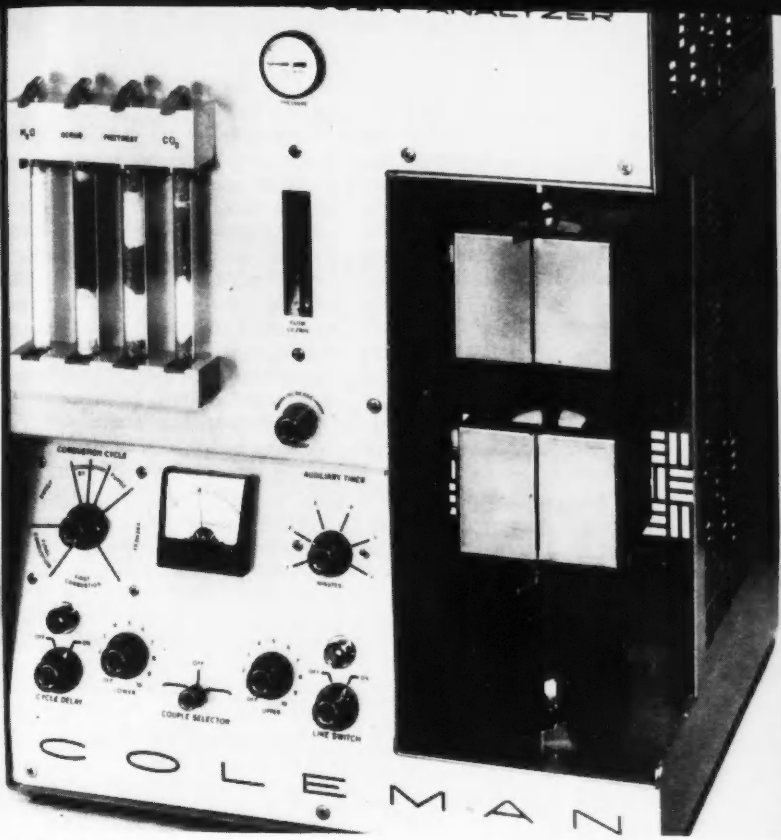
The original contact of OED members with the CBA course was through a Seminar on the Teaching of Chemistry held at Greystones, Ireland in March of 1959. This seminar was sponsored by the Organization for European Economic Cooperation, since changed to OED. Laurence Strong and Paul Westmeyer of CBA, as well as J. A. Campbell and Robert Rich of CHEMS, were involved in the discussion groups. Out of these discussions was developed a suggested syllabus for two years of secondary school chemistry. The syllabus has been refined by a committee of European chemists, and it is this two-year course which was discussed in the 1961 summer institute.

Professor John Aherne of the Crawford Technical Institute in Cork, Ireland participated in the CBA summer institute at Kenyon College in 1960, and was instrumental in setting up the 1961 meeting in Ireland. Sections of the syllabus were presented by chemists from various OED member countries. Belgium had charge of the Junior course presentation; Sweden, The United Kingdom, Ireland, France, and Germany of portions of the Senior course. The United States team presented "structure, bonding, reactivity, shapes of molecules, periodicity, etc. — general overall applications of bond theory to facts of chemistry." Part of the time was devoted to laboratory work and to building and discussing the uses of Styrofoam models.

Urine Test for Heart Damage

➤ A RELATIVELY simple and accurate test for heart damage using only a small sample of a patient's urine has been developed at the University of California, Los Angeles Medical School.

Drs. Robert B. and Richard W. Kalmansohn, brothers, developed the procedure which they call the urine glutamic oxalacetic transaminase (UGOT) test. The test measures the rate of repair of heart damage.



Apparatus Article

Carbon-Hydrogen Analyzer

➤ A NEW instrument for laboratory determination of carbon and hydrogen is being produced by Coleman Instruments, Inc., Maywood, Illinois manufacturer of instruments for analytical chemistry. The instrument, the Model 33 Carbon-Hydrogen Analyzer, was formally introduced to the scientific community at the Pittsburgh Conference on Analytical Chemistry.

Essentially an automated form of the time-tested Pregl method, the instrument permits rapid, accurate analysis of carbon and hydrogen in practically all classes of substances which pyrolize at temperatures under

1100° C. For routine analyses, the instrument yields results corresponding to theory within ±0.2% carbon and ±0.2% hydrogen; usual sample size is 5-50 mg. It is expected to be most valuable in research and control laboratories concerned with such materials as foods, petroleum, pharmaceuticals, plastics and chemical intermediates.

The Carbon-Hydrogen Analyzer is economical to operate. All reagents are readily available; sweeping gas is extra-dry grade oxygen. Space requirements are minimum — only 18 inches of laboratory bench space are needed for the instrument.

Great savings in time and labor — and considerable improvement in analytical accuracy — result from automating the various phases of the analysis. The instrument's complete cycle requires only 8 minutes, compared to an average of 30 minutes for a manual analysis. Programming of all variables of the analysis — combustion periods, temperatures, flow rates — and automatic completion of the pre-selected program provide great improvement in accuracy and reproducibility over manual methods of analysis. The instrument completely eliminates one important source of analytical error — variations in operator technique.

Operation is simple and straightforward. A weighed quantity of a substance under investigation is completely burned in an atmosphere of pure oxygen. Carbon combines with the oxygen; carbon dioxide is absorbed in a tube containing Ascarite. Hydrogen combines with the oxygen; water is absorbed in a tube containing anhydrous manganese perchlorate. Nitrates, sulfurs and halogens are absorbed in separate locations in the combustion train. Percentages of carbon and hydrogen contained in the sample then are calculated from the weight increases of the absorption tubes.

Great inherent flexibility makes the instrument useful in the analysis of an unusually wide range of materials. Solids are easily analyzed . . . special sample-handling techniques permit analysis of liquids, hygroscopic materials and volatile materials. Furnace controls permit selection of any combustion temperature from 700° to 1100° C. An auxiliary timer may be used to extend the combustion period as much as 5 minutes for analysis of difficult materials. Flow rate controls adjust the sweep rate to requirements of individual materials.

Science Aids Available

► A NEW aid to youngsters and adults interested in science is now available.

Called Wonderful World of Science, the paperback book describes thousands of science materials which can be obtained free or at very low cost. These include booklets, films, kits, games and experiments in every scientific field, which have been prepared by professional organizations, Government and industry.

The Science Service-Bantam Book publication tells how to obtain materials covering everything from astronomy to zoology. This 50¢ source book was edited by Shirley Moore and Judith Viorst, with illustrations by Don Trawin.

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

High Purity Butyllithium

➤ Now on stream at New Johnsonville, Tennessee, Foote Mineral Company's butyl lithium plant is the first and largest facility of its kind in operation. It features large-scale production (100,000 lbs./yr. at normal rates) and high purity organolithium chemicals. Foote is presently shipping its production in tank truck loads.

Foote butyl lithium is a standard catalyst for synthetic stereo-specific polymers such as synthetic Hevea (polyisoprene) and polybutadiene. Polyisoprene is the new synthetic rubber that has all the desirable properties formerly possible only with the natural type. Butyl lithium and other organic lithium compounds are being extensively investigated by the rubber, pharmaceutical, and petroleum industries. Possible uses include: intermediates in organic reactions; catalysts in the manufacture of stereospecific polymers in addition to polyisoprene.

The New Johnsonville operation is completely integrated and set up to produce lithium metal dispersions, n-butyl lithium, and *sec*-butyl lithium (other lithium alkyls will be added later). Also available are facilities for storing raw materials, disposing of waste safely and efficiently, and shipping finished products to customers promptly.

Both plant and process were designed and engineered by Foote technical personnel who worked with data obtained in extensive laboratory research. The Foote process emphasizes strict quality control. Result — high purity of the finished product, even on the large production scale now possible.

The production line chemical now offered to industry is highly reactive and contains a minimum of 96 per cent carbon-bound lithium.

Anionic Surfactants

➤ Development of two new anionic surface active agents, alpha-sulfopalmitic and alpha-sulfostearic acids, has been announced by Armour Industrial Chemical Company.

Both acids, known as Armosul 16 and Armosul 18, respectively, are difunctional compounds having a strongly acidic, sulfonic acid group and a weakly acidic, carboxylic acid group within the molecule. Both acids and various derivatives have unusual solubility and surface active properties.

Known applications of Armosul acids include improved detergent formulations at lower costs by combining alkali metal, ammonium, or substituted ammonium salts of sulfated aliphatic alcohols with similar salts of alpha-sulfonated fatty acids. In addition, improved detergency can be obtained by replacing some of the alkyl aryl sulfonates, which are relatively ineffective detergents, with a mixture of salts of Armosul acids and sulfated alcohols.

Salts of Armosul acids can also be used as the main ingredients for detergent bars. A salt of Armosul 18 may be used in the production of high dropping-point greases and some salts of Armosul acids have proven effective flotation reagents for removal of mineral impurities from silica sand to assure quality glass products.

Armosul 16 and Armosul 18 are available in pilot plant quantities. They are off-white, slightly hygroscopic powders which are soluble in water and polar organic solvents.

Methyl Ethyl Ketone

➤ "PROPERTIES and Essential Information for Safe Handling and Use of Methyl Ethyl Ketone" is the title of the latest chemical safety data sheet, SD-83, now available from the Manufacturing Chemists' Association, Inc.

The safety data sheet details the properties, hazards, engineering control of hazards, employee safety, fire fighting, handling and storage, tank and equipment cleaning and repairs, waste disposal, medical management and first aid.

The phamphlet describes Methyl Ethyl Ketone as a flammable liquid with a low flash point, the vapors of which form explosive mixtures with air. SD-83 points out that although industrial use of this chemical does not present a serious health hazard, undesirable effects may occur from inhalation of excessive concentrations of vapor, prolonged or repeated skin contact with the liquid, and from contact of the liquid with eyes.

Copies of SD-83 are available for 30 cents per copy from the Manufacturing Chemists' Association, Inc., 1825 Connecticut Ave., N.W., Washington 9, D. C.

Pseudocumene

➤ AVAILABILITY of pseudocumene in commerical bulk quantities has been announced by Enjay Chemical Company. Previously available as a market development chemical, pseudocumene (1, 2, 4-trimethylbenzene) is now offered commercially at a spot price of 11 cents per pound f. o. b. Baytown, Texas.

According to E. W. Bowerman, manager of Enjay's Chemical Raw Materials Division, "this new spot price combined with availability in commercial quantities makes pseudocumene attractive for a number of new end-use applications, including: trimellitic anhydride, methyl dicarboxlic acids and dimethylcarboxylic acids — all of which have potential in the surface coatings field; for conversion to intermediates suitable for dyes, pharmaceuticals, insecticides, fungicides and other interesting chemical intermediates."

Commercial specifications for pseudocumene include a 95 per cent minimum purity with a 98 per cent minimum total aromatic content. Typical inspections are: boiling range 335-340 F, water-white color, flash of 123 F.

Dr. Bowerman pointed out that Enjay's pseudocumene, which is supplied from Humble Oil & Refining Company's plant at Baytown, Texas, is the first of several higher polymethylbenzenes to reach the commercial stage. Others now in the active market development stage include mesitylene (1, 3, 5-trimethylbenzene),

durene (1, 2, 4, 5-tetramethylbenzene) and meta xylene (1, 3-dimethylbenzene).

Enjay Chemical Company, A Division of Humble Oil & Refining Company, is a supplier of olefins, alcohols, oxo alcohols, ketones, ethers, asters, aromatics and other chemicals to industry; Escon polypropylene; Buton resins for paints and plastics; Enjay butyl rubber; and Paramins, additives for fuels and lubricants.

For further information, write Enjay Chemical Company, Room 1903, 15 West 51st St., New York 19, N.Y.

Petroleum Additives

➤ A NEW BOOKLET covering use of aliphatic organic chemicals as additives for gasoline, fuel oil, lubricants and asphalt has been prepared by Armour Industrial Chemical Company.

Named Armour Aliphatic Organic Chemicals for Refined Products and Processes, the booklet reviews the application of these chemicals in each area.

As gasoline additives, Armour chemicals are used as anti-icers and corrosion inhibitors, in fuel oil they act as inhibitors and dispersants of sludge, in lubricants they serve as extreme pressure additives and corrosion inhibitors. Another group of Armour chemicals are used as acid inhibitors. In the asphalt field Armour chemicals serve as emulsifiers and as anti-stripping agents.

Copies of the booklet may be obtained by writing Armour Industrial Chemical Company, 110 N. Wacker Drive, Chicago 6, Ill.

Impurities in Table Salt

➤ DOCTORS who advise patients to stop eating salt to keep blood pressure down, probably are doing the right thing but for the wrong reason, research indicates.

Such measures are based on the idea that the sodium ion, an electricly charged portion of the salt molecule, is the prime cause of the high blood pressure. But new evidence uncovered by Dr. Lewis K. Dahl and Martha Heine at the Brookhaven National Laboratory in Upton, N. Y., has shown that some impurity in the salt is just as likely a culprit.

High blood pressure, the investigators noted, is common among the Japanese, whose table salt comes from sea water and contains a mixture of substances picked up during processing. Impure table salt also is used by many other groups.

In experiments with rats, the scientists found that there was less high blood pressure among the animals who ate chemically pure sodium chloride than among those who ate sea salt. After 14 months of eating excessive amounts of salt, the pure-salt rats averaged a blood pressure of 158, the sea-salt rats nearly 180. Anything above 140 was considered abnormally high. Control rats, those fed normal amounts of salt, averaged 120 at 14 months.

The impurity that seems to cause higher blood pressure has not been identified, the researchers reported in the Journal of Experimental Medicine. They suspect a metal ion, but have not yet determined which one, if any, is responsible.

Dynamic Chemical Expansion

A size-up of what lies ahead in the U. S. chemical industry has been made by the nation-wide brokerage house, Merrill Lynch, Pierce, Fenner & Smith, Inc., and CHEMISTRY presents in part this copyrighted evaluation, by permission, as a service to its readers.

➤ THERE ARE numerous signs the mighty U. S. chemical industry is about to resume its historic growth trend. There have been short interruptions, but over the decades the chemical industry has grown twice as fast as the total U. S. economy. To be exact, over-all industrial production has climbed an average of 3½% annually since 1941 while the chemical industry has gained 7% a year.

An interruption came in 1959-60 when the industry was caught in the same profit squeeze which bedeviled thousands of corporations from coast-to-coast. In the chemical business itself severe competition from both within and without forced down the prices of many products. The chemical companies frequently cut prices themselves to increase markets but the recent surge of competition forced prices down faster than costs could be adjusted. Hence in 1960 the industry maintained its traditional growth pattern by increasing sales 8% to an all-time high of $27.7 billion but net profits were down 7%.

These developments were observed by big and little investors and starting in 1959 the chemical securities began to lose their appeal as growth and glamor stocks. This trend was aggravated because a large segment of the investing public discovered other glamor stocks to replace the fading chemicals. Hence at their 1960 low the ten leading chemical stocks used in the Merrill Lynch index were 30% below their 1959 high whereas the Index of 540 stocks was down only 12%.

Recently the chemical stocks have begun to pick up some of their old-time investment appeal. By May 1961 chemical stocks had already recovered 24% from their lows of last year.

Decades of Growth

From a small, little-known industry 60 years ago, the chemical business has grown into the nation's fourth largest manufacturing complex. The U. S. Government's latest *Quarterly Financial Report for Manufacturing Corporations* lists the industry's assets at more than $24 billion. Behind these figures are more than 12,000 plants which turn out over 11,000 compounds and provide over 880,000 jobs.

Chemistry never stands still. In the past 15 years alone the industry has invested over $1 billion a year in new

or improved plants and equipment. Despite recession and profit woes, the industry invested $1.6 billion in new plants in 1960 while the 1961 budget calls for an all-time record of over $1.7 billion.

Research is an outstanding characteristic of the industry. These days the industry invests $700,000,000 annually in research and development to produce some 400 new products every year. This is why company after company reports that 30 or 40 or even 50% of current sales come from products not even on the market five years ago.

The role of the chemist is to take natural or artificial substances and convert them into something more useful, more exotic or even brand new — and preferably at lower cost. The chemists have been so successful their products are vital to every major industry in the world not to mention human life (drugs) and national defense (rockets and space).

Because possible chemical combinations are literally limitless, the industry considers it an every-week occurrence to discover a brand new product for which there is no apparent market. Says du Pont de Nemours vice president David H. Dawson: "New products seldom emerge from the laboratory to find a ready-made market awaiting."

The extreme versatility of the industry is a major reason why future growth seems almost endless. As in the past there will be a continuous parade of new products and techniques for home, farm and industry. Add to this the intense need for custom-made items for advanced electronics, bigger rockets, space travel and the preservation and extension of human life.

These are some of the reasons why sales projections go into the financial stratosphere. Total industry sales were $4.9 billion as recently as 1940. They spurted to $16.4 billion in 1950 and rose anew to last year's record. If the industry maintains this rate of growth, total sales should reach $54 billion in 1970 — an estimate which may prove conservative. Behind this growth will be the stimulus of expanding research — today the industry spends three cents of every sales dollar for research compared with one penny for all U. S. industry. The ratio may go higher.

As might be expected, not all segments of the chemical industry will grow at the same pace. In the next decade entirely new product lines may expand into large industries in much the same way petrochemicals have developed in the past decade. But at the present the fastest-growing major fields appear to be plastics, synthetic fibers, agricultural chemicals and industrial gases. Here are brief reviews of these chemical segments:

Plastics

Plastics probably is the fastest growing area of the chemical industry. Once considered cheap substitutes for scarce materials, they have now gained wide acceptance. Today plastics are everywhere — furniture, appliances, luggage, toys, signs, business machines, shower curtains, radio & TV cabinets, swimming pools, pleasure boats and aircraft. In each case plastics are used because of their own merits. More and more they are replacing other materials, sometimes as substitutes but usually as superior materials.

The growth of the plastics industry is remarkable. Since War II sales have practically doubled every five years. Production climbed from one billion pounds in 1946 to two billion in 1950, four billion in 1956 and six billion in 1960. Most of the big chemical outfits like Union Carbide, du Pont, American Cyanamid, Dow and Monsanto have been in the business from the start. But they have been followed gradually by many non-chemical firms — first by the oil and rubber companies, more recently by corporate giants like Eastman Kodak, W. R. Grace, Koppers and National Distillers.

Best-known of the postwar plastics is *polyethylene*. To the consumer this is the material which goes into squeeze bottles, flexible pipe, containers and packaging film. Production has soared from less than five million pounds a year during War II to a hefty 1,325 million pounds in 1960.

Less than a decade ago du Pont and Union Carbide were the only commercial producers of polyethylene. Since then they have been followed by more than a dozen companies — Monsanto, Dow, Spencer Chemical, Eastman Kodak, Koppers, to mention a few. Markets where polyethylene is still embryonic include automatic over-wrapping and packaging of fresh produce.

Despite its versatility, polyethylene has two major drawbacks. For some uses it is too soft and flexible; in any use the cost of polyethylene plants is high.

Several years ago chemical researchers came up with a way of making polyethylene without using extremely high pressures. The new plastic has variously been called low-pressure, high-density, linear or rigid polyethylene. It is stiffer than high-pressure poly, resists oils and acids better, has five-to-seven times more tensile strength, and it softens at a temperature of about 245°-to-260° F. *v* about 200° F. for conventional poly.

Celanese was the first in the U. S. to get into commercial production early in 1957; it was soon followed by Phillips Chemical and Hercules Powder. Others in production include Union Carbide, Koppers, W. R. Grace and Allied Chemical. Today's industry capacity is around 330,000,000 pounds. One area where current use is low but future needs large is automotive parts.

Part of the same family is *polypropylene* which is tougher, stronger and more heat-resistant than polyethylene. In addition, it is made from an abundant petrochemical product of oil refineries which costs less than one-fifth as much as polyethylene's raw material. Sales are estimated to have totaled 40,000,000 pounds in 1960. They are expected to more than double in 1961 and then triple to about 250,000,000 pounds in 1962.

The first U. S. polypropylene plant was brought on stream late in 1957 by Hercules Powder. In mid-1961 Avisun (American Viscose & Sun Oil), Dow, Humble Oil and Novamont (U .S. subsidiary of Montecatini) had plants. According to *Chemical Week* capacity is estimated at 135,000,000 pounds a year. Shell Chemical, Texas Eastman and Firestone will add to capacity which is estimated to reach 545,000,000 pounds by the 1962 year-end.

Another fast-growing plastic is *polyurethane* which looks like foam rubber. In flexible foams, this plastic goes into fire-resistant furniture upholstery, insulation linings for winter clothes, insulation for refrigerators, auto crash pads and seat cushioning. The "rigid" variety is used in construction materials, airplane wings, railroad refrigerator cars and so on. Total production reached about 100,000,000 pounds in 1960. Within five years the flexible type is expected to total 200,000,000 pounds while the rigid form may reach 100,000,000 pounds. Principal producers are Mobay (Monsanto and Farbenfabriken Bayer), du Pont and Allied Chemical, all of whom are adding substantially to their capacity.

Meanwhile, there are many more plastics on the way. One of the new plastics families is the polycarbonates, made by General Electric and Mobay Chemical. GE's product called *Lexan* is being produced in a recently-opened 5,000,000-pound plant. GE anticipates a slow start of 6-to-12,000,000 pounds by 1962, increasing to 30-to-50,000,000 by 1965 and perhaps to 100,000,000 by 1970.

The unusual properties of these plastics are expected to offset their high price. They can frequently replace metals, and have tensile strengths comparable to many. Under the name *Delrin* (made by du Pont) the polyformaldehyde family of plastics has already been commercialized. Recently Celanese introduced *Celcon*, a copolymer with properties which may make it competitive with *Delrin* and GE's polycarbonate plastic *Lexan*. Du Pont has filed a patent suit asking the court to enjoin Celanese from production of *Celcon*, alleging infringement on the patent on *Delrin*.

Synthetic Fibers

Synthetic fibers represent another segment of the industry which should continue to show substantial growth. Use has skyrocketed from 35,000,000 pounds in 1945 to 613,000,000 in 1960. Many "miracle" fibers have penetrated and revolutionized the textile market. As they are further improved, they invade other fields.

For the most part, synthetics have grown at the expense of other fibers such as silk, wool and cotton. Now they are gradually overtaking the cellulosics (rayon and acetate). Though the cellulosics were the first successful man-made fibers, they are not considered "true" synthetics. Reason: they are based on cellulose from cotton and wood. While the total man-made fiber market has expanded, cellulosics consumption in recent years has held more or less steady around one billion pounds while the synthetics have shown steady gains.

The synthetic fiber industry got its start with the introduction of *nylon* by du Pont just before War II. Its growth has been phenomenal — from 10,000,000 pounds in 1941 to about 380,000,000 in 1960. Pioneer du Pont is still first in the field. Others include Chemstrand, Allied Chemical, Dow Chemical as well as rayon producers Amrican Enka and Beaunit Mills.

While nylon is best-known for its use in women's hosiery, it goes into large quantities of sweaters, lingerie and work clothing. It is also expanding into non-apparel markets. Biggest industrial use is in tire cord where nylon accounted for more than one-

third of the total 1960 production. Apparently, producers of nylon tire cord are betting on a still larger share of the market since a number of them are adding substantially to capacity. In any case, total nylon consumption is expected to show an increase of about 40% over the next five years.

Large gains have also been posted by the acrylic family of fibers. The first acrylic *Orlon* was introduced by du Pont in 1950. Since then have come Chemstrand with *Acrilan*, Union Carbide with *Dynel*, American Cyanamid with *Creslan*, Tennessee Eastman's *Verel*, and Dow's *Zefran*. Du Pont accounts for 60% of current acrylic production and Chemstrand for about 25%. Biggest use for acrylics is sweaters which take some 50,000,000 pounds a year. In addition, they go into non-apparel items such as rugs, blankets, industrial fabrics and in protective and work clothing. Acrylics are expected to continue their fast growth, with consumption doubling by 1965.

Dacron, introduced by du Pont in 1953, was long the only commercial member of the polyester family of synthetic fibers until Tennessee Eastman introduced its *Kodel* and Celanese its *Fortrel* (with Imperial Chemical Industries). Polyesters are seldom used in 100% form but mostly in blends with other fibers, where their drip-dry features have a great deal of appeal. Demand for these fibers, too, is expected to increase by 100% by 1965.

Among other synthetics is Dow's *Saran*. Because of its ultraviolet resistance, *Saran* has gained acceptance in outdoor furniture, and in upholsteries where its flame-retardant qualities are important. Spandex, a fiber with extremely high elastic properties is produced both by du Pont *(Lycra)* and U. S. Rubber *(Vyrene)*. It is primarily intended for lightweight foundation garments and swim suits.

Agricultural Chemicals

Agricultural chemicals should continue to be an expanding profitable business for chemical producers. Since 1940 the American farmer has more than doubled his harvest despite fewer hands and fewer acres. One reason for his advances is his use of farm chemicals.

Many more will be needed. Losses from insects, diseases and weeds still run into billions of dollars. In addition, the rising world population will cause the demand for fertilizers to increase sharply.

One of the biggest developments has been the use of commercial fertilizers. Production has climbed from about 3,000,000 tons around 1900 to some 25,000,000 tons a year. A leader in farm chemicals is Allied Chemical which began the manufacture of anhydrous ammonia, which is rich in nitrogen. Nitrogen along with phosphate and potash are nature's three major stimulants to plant growth. Other important producers of anhydrous ammonia include Phillips Petroleum, Monsanto, Olin Mathieson, du Pont, Dow, Spencer Chemical and others. Fertilizer sales are estimated at $1 billion in 1960 and may double by 1975.

Chemical firms are greatly interested in specialty farm chemicals since they are high-profit items. These are the herbicides (for weeds), fungicides (for plant diseases), insecticides (insects and pests) and nematocides (for

worms). The large chemical companies produce the basic chemicals anyway. If they can upgrade them into farm chemicals, these can be very profitable items.

In any case, there is an enormous need for such chemicals. The Department of Agriculture estimates that weeds are causing crop damage of about $4 billion a year, plant diseases another $3 billion and bugs $3-to-5 billion a year. Thus the demand is almost limitless. Sales of such chemicals totaled $285,000,000 last year and are expected to reach $1 billion by 1975. While this would still represent a small part of over-all chemical activity, it would be a highly profitable sideline.

Industrial Gases

Industrial gases represent still another fast-growing sector of the chemical industry. In recent years this field has expanded even faster than the industry itself — from 1950 through 1959 sales grew a hefty 160% *v* 90% for all chemicals.

A major reason for the expansion in oxygen sales has been the increasing use by the steel industry. In fact, despite the low operating level of the steel industry in 1960, the use of oxygen was up. One reason was the steelmakers found use of oxygen in open hearth furnaces cuts costs. The chemical industry's demand for oxygen is also increasing; as is medical oxygen consumption. Total demand should rise about 70% by 1965.

Hydrogen is used in the production of vegetable oils, also finds use in electronics in the treatment of various specialty metals. It has also received a great deal of publicity because of developments involving the use of liquid hydrogen as a missile fuel. When used with liquid oxygen, it gives a thrust 40% higher than some current combinations. Use in missiles is expected to multiply at least five times by 1965. Over the same period, total hydrogen demand should more than double.

Meanwhile, nitrogen has won wider use in steelmaking, space applications, electronics, chemicals and cyrogenics (extreme cold). The use of argon in welding, aircraft, electric lamps and electronics is up. As a result of the Government's program to buy helium from private industry, production of this gas should rise considerably in the next few years.

Thus, total demand for industrial gases should grow at a rate of at least 10% a year over the next five years. Major producers include Union Carbide, Air Reduction, Air Products and Chemetron.

New Radiation Detector

➤ A NEW radiation dosimeter for research and general use has been developed by University of Wisconsin scientists. Lithium fluoride crystals, which store light created by bombardment of high-energy radiation, are used, Drs. J. R. Cameron, D. Daniels, Noye Johnson and G. Kennedy reported in Science. The light is given off by heating the crystals (thermoluminescence) and the light's intensity, which depends on the amount of radiation, is measured. The dosimeter has a wide spectrum for detecting electromagnetic radiation and is simple to use, the scientists claimed.

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

Mass Production Animal Tissue Growth

➤ THE GROWING of living animal tissue under controlled laboratory conditions is fairly common, but an invention patented by a Dayton, Ohio, man may be the first attempt to put it on a "mass production" basis.

Harry A. Toulmin Jr., awarded patent No. 2,996,429 for the process and the equipment, said his method will "grow large quantities of tissue in short periods of time." He assigned rights to National Toxicological Laboratories, Inc., Dayton.

He points out that tissue is needed in large amounts for cancer research, vaccine production and other medical efforts.

Drug companies now producing poliovirus vaccine, for example, grow each batch of virus on kidney cells taken directly from the monkey. This technique requires a large number of expensive monkeys. A mass production tissue culture method, however, essentially would give laboratories a big, growing, monkey kidney in a huge test tube. Individual laboratories now usually produce only enough to supply their own basic research requirements.

The Toulmin technique involves a rectangular culture chamber holding a cylinder-shaped drum to which a semi-porous cellophane membrane is fastened. The culture removed from an animal body for controlled growth will adhere to this membrane.

The drum is revolved slowly (about 12 revolutions per hour) through a nutrient bath of animal serum and embryo extract, which gradually soaks through the culture and the membrane. A gaseous mixture of oxygen, nitrogen and carbon dioxide, necessary for atmospheric conditioning and tissue respiration, is added to the chamber through a filtered pipe. Additional control is provided by interior lighting.

Used nutrient and gases can be pumped from the chamber and fresh supplies introduced in a continuous process until the desired growth level is reached. The new tissues can then be removed through transparent panels that also permit close observation of the growth process.

"Fingerprints" Mass Casualties from Nuclear Attack

➤ A "FINGERPRINTING" method designed for tracking down criminals or identifying victims of a nuclear attack has been patented.

Dr. William D. Stewart and Joseph A. Terek, research scientists at Atlantic Research Corporation, Alexandria, Va., received patent No. 2,986,831 for a fingerprinting process that forms a plastic "cast" of an imprint.

Designed originally for identifying

mass casualties in time of an atomic war, the method is now extensively used for solving crimes by the Canadian Mounted Police and various police departments throughout the United States. The Federal Bureau of Investigation (FBI) is also reportedly interested.

A fine powder is first sprinkled on a fingerprint, followed by a spray of liquid plastic (polymer). The plastic film hardens in a few minutes, trapping a powdered imprint, and is then peeled off. The film does not smudge the fingerprint and can be stored as a permanent record, the patent stated. Dr. Stewart has already received more than 40 patents for various synthetic rubber compounds and plastics.

Balloon Altitude Research

➤ A MANNED balloon capsule for studying the upper atmosphere has been patented.

The capsule, one of a series designed for the U. S. Navy's upper atmospheric program, Project Stratolab, was invented by Harold E. Froehlich, New Brighton, and Richard L. Schwoebel, Minneapolis, Minn. Rights of patent No. 2,993,663 were assigned to General Mills, Inc.

"Photographing the atmosphere of other planets in the clear air of the stratosphere and measuring its temperature, ozone content and pressure have been accomplished with these manned balloon junkets." Mr. Froehlich told Science Service in a telephone interview. In 1956, the first flight in one of these balloons during Project Stratolab lofted Malcolm D. Ross 70,000 feet above the earth, a record height at that time. Since then, a manned balloon flight has topped the 100,000-foot mark.

The compactly built, cylindrical shaped gondola is suspended from a plastic bolloon at a 30- to 60-degree angle to provide the smallest possible shell enclosing a man in a sitting position. The flight is controlled by releasing ballast.

The gondola's aluminum-coated nylon "skin" reflects the sun's hot rays during the day, whereas an inside layer of aluminum prevents excessive loss of heat from the pressurized cabin during cold nights. An adjustable seat permits the "space man" to reach the instruments easily or view the upper atmosphere through a porthole.

Diamond-"Growing" Method

➤ AN IMPROVED method for controlled "growing" of diamonds has been patented by Harold P. Bovenkerk, Saratoga, N. Y., who assigned rights to patent No. 2,992,900 to General Electric Company.

The Bovenkerk system is said to produce "superior individual diamond crystals." Discs of non-diamond carbon material, such as graphite, and discs of various metal alloys, serving as catalysts, are stacked alternately in a new type of reaction chamber. When high pressures and high temperatures are applied, the carbon changes to diamond form.

Mr. Bovenkerk indicated that the best results were achieved when the alloy was made from an elemental catalyst metal combined with one of the strong carbide-forming elements, such as titanium, zirconium, boron, silicon, iron, manganese ,and tungsten. The melting point of the alloys is lowered, and the diamond-producing catalytic reaction increases. Why

this happens "is not understood at the present time," he said.

He said "true diamonds" that passed standard tests for quality and density were obtained. The method reportedly improves on previous techniques of "growing" diamonds in cluster formation, which may inhibit growth of individual diamonds and cause surface irregularities.

Drug Reduces High Blood Pressure

➤ A NEW DRUG that effectively reduces high blood pressure stemming from many different causes has been patented.

A trio of doctors working for the Schering Corporation laboratories in Bloomfield, N. J., won patent No. 2,986,573 for a drug that lessens and helps control hypertension resulting from unknown causes and certain circulatory or vascular diseases. The doctors, who assigned the patent rights to Schering, are John G. Topliss of East Orange, Nathan Sperber of North Caldwell, and Alan A. Rubin of Bloomfield, N. J.

"Preliminary clinical work done with the new drug shows promising results," Dr. Rubin stated. "We think this is a unique drug because it appears to work directly on the arteries which are especially affected by high blood pressure." Less side effects were also observed compared to drugs commonly used today, he emphasized.

The drug with the chemical name of 2-methyl-7-chloro-1,2,4,-benzothiadiazine-1,1-dioxide was first tried on dogs and rats in the laboratories. Hypersensitive rats were fed small drug dosages daily from four to eight weeks, appreciably reducing and maintaining the lowered blood pressure for the entire experiment.

Similar experiments on humans bore similar results. One hypersensitive patient's blood pressure returned to his previous high "normal" within one week after therapy stopped.

"Space-Age" Technique In Working Metals

➤ THE SPACE age has come to the metal-working industry with a new patented technique for welding metals used in jets and space probes.

James S. Kirkpatrick of Dearborn, Mich., has patented a method (No. 2,985,129) for welding such valuable metals as titanium, zirconium and molybdenum. Rights were assigned to Brooks & Perkins, Inc., Detroit.

The welder, wearing a glass or plastic mask, does all welding in a huge tank with a controlled atmosphere. All oxygen, which easily combines with the metals during welding to form bothersome oxides, is removed from the chamber and is replaced by an inactive gas such as helium or argon. A pair of sleeved armholes below a view glass near a working bench permits another person outside the tank to assist the welder.

Sound-Absorbing Wall Panels

➤ A DURABLE glass fiber wall panel that absorbs loud noises from industrial machinery has been patented.

The wall panels are so durable they can be used under the most severe conditions, inventors Frank O. Brisley and Ulysses T. Gambill of Newark, Ohio stated in patent No. 2,984,312, assigned to Owens-Corning Fiberglass Corporation of Delaware.

Besides acting as a sound absorber and heat insulator, the durable panels also have a plastic surface, pock marked with air holes, that resists

sharp blows without fracturing. The surface, which protects a matted glass fiber layer, can be easily washed and painted without hampering the panel's effectiveness.

Mr. Gambill also received patent No. 2,984,313 for a glass fiber panel especially suited for cushioning articles or baggage during transportation. Patent rights were also assigned to Owens - Corning Fiberglass Corporation.

Ordinary Substances Give Off Radiation

➤ TINY PILES of metal powder give off soft radiation.

Distinct radiation imprints were discovered on X-ray film exposed to such ordinary substances as zinc powder and aluminum filings. The imprints were probably formed by a soft electron flow from the metals, reported Dr. Stuart McLean of the General Electric Company's Lamp Research and Development Operation, Cleveland, Ohio.

The powders, sometimes mixed with a medium, were inserted in holes gouged out of wooden blocks and X-ray films attached to the blocks were exposed for 48 hours.

X-ray patterns showed up even when the film was moved six inches away from the source, the scientist stated. The patterns varied with different pressures and temperatures, suggesting the radiation "producer" is closely tied with the kinetic condition of the source, Dr. McLean reported in the British journal, Nature. Similar effects on X-ray film were also obtained from organic mixtures.

√ *Chemistry Quiz* √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 39.

A. Which of the following elements is chemically least like the other three?
   1. Lithium
   2. Magnesium
   3. Zinc
   4. Cadmium

B. A meson is
   1. a recessive gene.
   2. a radioactive isotope.
   3. an acid-base indicator.
   4. a sub-atomic particle.

C. Calcium acid phosphate is used in
   1. alloys
   2. pigments
   3. baking powders
   4. paints

D. Polonium is
   1. an alloy
   2. a metallic element
   3. a Shakespearean character
   4. a satellite of Jupiter

E. The process by which a crystalline hydrate loses water to the atmosphere is known as
   1. deliquescence
   2. effervescence
   3. efflorescence
   4. triboluminescence

For the Home Lab

Sulfides

by Burton L. Hawk

➤ Despite its long-standing evil reputation, due to its association with foul smelling compounds, sulfur is really an amiable element. It combines readily and easily with many other elements to form a group of useful sulfides. Several of these sulfides are brilliantly colored and find use as pigments for paints. Many metal sulfides occur in nature and represent important ores for the metals.

Sulfides can be prepared in the laboratory by reaction of a soluble sulfide with a solution of the metallic salt (which we shall call the "wet process"), or by the direct union of the two elements (which we shall call the "dry process").

Wet Process:

Arrange 14 test tubes in a row on your table and fill each half full with solutions of the following compounds, respectively: Mercuric chloride, lead nitrate, silver nitrate, cupric sulfate, bismuth nitrate, arsenious chloride, cadmium nitrate, antimony trichloride, stannous chloride, ferrous sulfate, zinc sulfate, manganese sulfate, nickel sulfate and cobalt nitrate. Of course, if you do not have any particular compound mentioned you may substitute any other soluble salt of the same metal. If the lead nitrate solution is cloudy, add a few drops of nitric acid to clarify it. Also add a few drips of nitric acid to the bismuth nitrate solution to prevent formation of the insoluble subnitrate. Arsenious chloride may be prepared by dissolving arsenious acid (arsenic trioxide) in dilute hydrochloric acid. Be careful — this solution is very poisonous! Add a few drops of hydrochloric acid to the antimony trichoride solution to prevent precipitation of the oxychloride.

Now prepare a solution of sodium sulfide and pour a few cc. of this solution into each of the above test tubes. Note the colors of the sulfides which are precipitated: mercury, lead, silver and copper — black; bismuth — brown; arsenic — bright yellow; cadmium — yellow; tin — yellowish brown; antimony — orange; zinc — white; manganese — pink; iron, nickel and cobalt — black. Note that most of the sulfides of this group are black, and only one, zinc, is white.

Dry Process:

You may find the direct combination of the elements more spectacular.

Mercuric sulfide. Place a small drop of mercury in a mortar and cover it with powdered sulfur. Grind the two elements together with the pestle. It is fascinating to see the characteristics of these two elements gradually disappear to form a grey powder instead. There is also a red variety of mercuric sulfide which is known as *vermillion* and is used as a paint pigment. To prepare the red variety it is necessary to heat the ele

ments. Place the mixture of mercury and sulfur in a porcelain dish and apply gentle heat. Stir and you will observe the brilliant red vermillion.

Ferrous sulfide. Mix together equal quantities of iron filings and powdered sulfur. Place in a dish and apply gentle heat. The sulfur will melt, unite with the iron, and a brown mass of ferrous sulfide will be formed.

Zinc sulfide. Zinc and sulfur celebrate their union with a brilliant pyrotechnical display. Mix together two parts of powdered zinc with one part of powdered sulfur and place in a neat pile on a metal dish. (Use only small quantities). The powders are then ignited by touching them with a hot glass rod. Keep your face away! The mixture will flare up quickly and burn with a shower of green flame and sparks. Be sure to ignite the mixture where there is no danger of fire from the sparks (preferably outdoors). If the mixture does not ignite with a hot glass rod, then try using touch paper, held with tongs. Touch paper is made by soaking filter paper in concentrated potassium nitrate solution. Thoroughly dry the paper, then cut into thin strips.

Stannic sulfide. Mix together equal parts of powdered tin and powdered sulfur. Mix in about one-quarter as much ammonium chloride. Place the mixture in a crucible and sprinkle a thin layer of ammonium chloride on top of the powders. Cover the crucible and heat rather strongly for a short while. Then, after the crucible has cooled, remove the lid and note the brilliant yellow leaflets which are sublimed thereon. This compound is known as "mosaic gold" and is used in gilding and bronzing metals.

Antimony Trisulfide. You may recall that the antimony sulfide we prepared by the wet process was orange in color. However, if the two elements are reacted together a black sulfide is obtained. Simply heat together equal portions of powdered antimony and powdered sulfur.

Hydrogen Sulfide:

Thus far we have ignored the most important of all the sulfides . . . and, for a very good reason. Hydrogen sulfide has a most disagreeable odor (rotten eggs) and in addition is quite poisonous. We recommend its preparation in the home laboratory only in very small quantities and with adequate ventilation. You will find that it has a way of permeating throughout the whole house with the result that you will find yourself quite unpopular with the rest of the family.

It is generated very readily by adding dilute hydrochloric acid to one of the sulfides; ferrous sulfide is the one commonly used. No need to tell you to sniff at the mouth of the tube . . . you'll smell it soon enough!

Answers to CHEMISTRY QUIZ on page 37.
A - 1; B - 4; C - 3; D - 2; E - 3.

Gold Hydrosol

DANIEL F. KANE JR.

J. E. Brown High School, Atlanta, Georgia

Daniel Frederick Kane, Jr., 17, was a winner in the 20th Science Talent Search. He hopes to major in physics at college in order to become a college teacher or a research scientist.

➤ LAST YEAR I repeated some experiments done the previous year (I had complete records) involving preparation of hydrosols using gold chloride and tannin solutions. The first year I had gotten a red, stable hydrosol; but in repeating I got a blue, unstable one. I had reason to believe that in the former case the tannin solution was, due to poor preparation, more concentrated.

This led me to relate certain facts I had learned in reading and to devise a hypothesis. According to Stoke's Law, sols containing larger particles are more unstable. Weiser states that gold hydrosols are red if particles are spherical and less than 80 mu in diameter, and purple to blue if particles are larger than 80 mu or agglomerate. Tannin has dual action as the reducing agent and protecting agent; it reduces the gold and forms a protective film around particles preventing their aggregation or further growth.

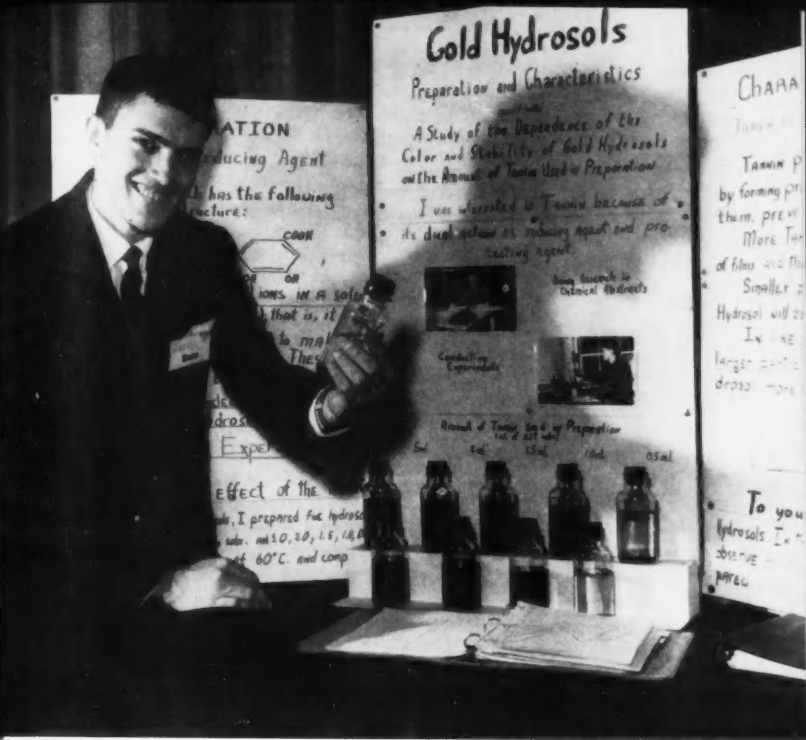
If larger amounts of tannin were used in preparing a gold hydrosol, the protective films would envelop particles more quickly, preventing growth and aggregation more completely; the hydrosol would be red and stable. Similarly, using small amounts of tannin, I could prepare a blue hydrosol. I liked this part. Never before had I been able intentionally to prepare a blue gold hydrosol. So I believed that concentration of tannin had an important effect on the color and stability of gold hydrosols.

I had seen a study on the breaking point of the protecting action of gum arabic. I decided to determine the breaking point of tannin protection in my study. Finding discrepencies, I repeated those done the second time yet a third and fourth time, the fourth immediately following the third to avoid differences in external conditions.

Finally I compared the hydrosols of all four attempts and recorded my observations.

Procedure

In the experimentation I kept all variables constant except the tannin concentration. From reading and previous experimentation I knew the best place to fix the variables. In all cases I started with 200 ml. of water, added 5 ml. of a 0.1% $AuCl_3$ solution, and heated to 60°C. Then, as the means of varying tannin concentration, I added, using a burette, pre-determined



➤ DANIEL FREDERICK KANE, JR. *with his science display which he exhibited in Washington as a feature of the twentieth annual Science Talent Institute. Daniel was one of the 40 Science Talent Search winners who were chosen from over 25,000 high school seniors throughout the country.*

volumes of a freshly prepared 1.0% tannin solution with regulated stirring on a magnetic stirrer.

I first experimented in various ranges of tannin concentration, using the tannin solution in volumes of 2.50, 1.50, 0.50, 0.10, 0.05, and 0.01 ml. Finding the breaking point of tannin protection to lie between the hydrosol with 0.50 ml., which was red, and that with 0.10 ml., which was purple, I successively used volumes of 0.09, 0.30, 0.20, 0.15, and 0.175 ml. in defining the breaking point.

Then comparing the eleven hydrosols, I recorded my observations on their relative colors. (In my reading I learned to compare colors as to hue, saturation, and brightness. Without the use of a spectrophotometer, I had to use my eyes in comparing hydrosols directly.) Although all the hydrosols were stable enough for months

to retain their color, after a week enough particles had settled to allow me to record observations on relative stability.

To validify my results, I repeated the preparation of those hydrosols with 0.50, 0.20, 0.15, 0.10, and 0.05 ml. of 1.0% tannin

Results

In the overall observations agreement was not complete, but it was sufficient enough to be acceptable while leading me to consider other factors.

All hydrosols prepared with volumes of tannin solution of 0.50 ml. or more were almost indistinguishable in color and stability. They were ruby red and very stable.

No observable hydrosol was formed when 0.01 ml. of tannin solution was used. The first hydrosol prepared with 0.05 ml. was a faint pink; the other three were faint blue, although slightly deepening after standing, due to continued reaction. All were relatively stable.

The results obtained in these extreme ranges indicates to me that my hypothesis is applicable only within limits. Above this point at which the tannin is completely efficient, further addition will not alter the hydrosol. Below some vague limit little gold is reduced, the particles are dispersed, and the hydrosol is stable, faint.

Of the first group of hydrosols prepared, that prepared with 0.30 ml. of solution resembled that with 0.50 ml. but with an apparent purple tinge. That with 0.20 ml. had more of the purple tinge; and that with 0.175 ml. had even more of the purple tinge, but with still an observable red base. The hydrosol prepared with 0.15 ml. of solution was decidedly purple; that with 0.10 ml. a darker purple. The hydrosol prepared with 0.09 ml. of tannin solution was dark blue. With only one exception (0.20 ml.) apparent stabilities declined as tannin concentration diminished.

The greatest discrepancy between the first and second trials arose in the hydrosols prepared with 0.20 ml. of solution. The second was purple, rather than red with a purple tinge, and more unstable. But the final two prepared with 0.20 ml. were almost indistinguishable and very similar to the first.

In the cases of the hydrosols prepared with 0.15 and 0.10 ml. of solution, each group of four hydrosols were similar in color and stability. In the former case the purple varied in saturation in the latter, the purple varied in amount of blue tinge with one hydrosol actually more blue than purple.

Conclusions

The results of my experimentation support my hypothesis; but also, they show that I can develop this project further. In my opinion it is evident that there is a consistant variation in the color and stability of gold hydrosols dependent on the amount of tannin used in preparing them. But can I not now stop to develop better controls on preparation and observation, then proceed to include in my hypothesis the idea of limits and the effects of changing gold chloride concentration or temperature? But even to this point, my study of the color and stability of gold hydrosols has been very worthwhile, a fascinating way to learn about scientific research.

Enjay

This article continues the series began during the last volume in CHEMISTRY. This series features the major companies employing chemists in the United States. Many of the students now preparing for a career in chemistry will eventually join one or other of the large corporations. This series is intended as a preview into the type work that they will be doing.

➤ JUST 31 years ago, petrochemicals represented a meager five per cent of the total organic chemical market in the United States.

Today, only three decades later, fully half of all chemicals consumed (on a dollar basis) are petrochemicals and one of the ten leading chemical firms in the country is a marketer of chemicals from petroleum — the Enjay Chemical Company.

Enjay, a division of the nation's largest domestic oil company, Humble Oil & Refining Company, is also the pioneer firm in the petrochemical field The company traces its history back to 1918, when isopropyl alcohol was first manufactured at the Bayway Refinery in Linden, New Jersey.

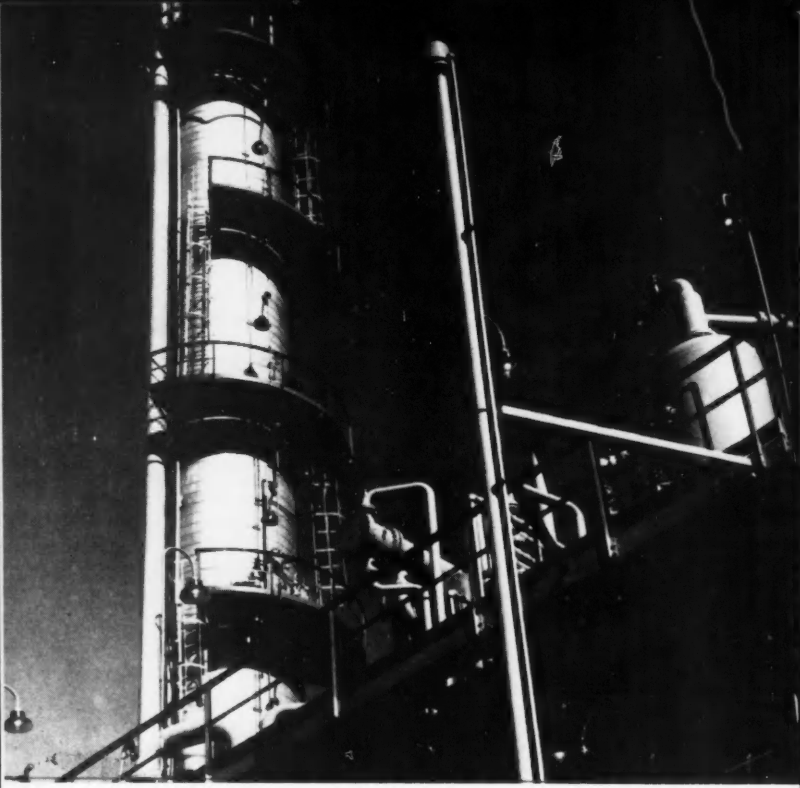
Since then, the company and its product line has multiplied and multiplied again, until Enjay now supplies industry with dozens of petrochemicals, some as staple as ethyl alcohol and others as exciting as tomorrow's newest plastic.

Enjay's petrochemicals can be classed in five product groups:

- Polymers, which include Enjay Butyl rubber.
- Plastics and Resins, such as Escon polypropylene plastic and Buton resins.
- Paramins, additives for fuels and lubricants.
- Industrial Chemicals, including alcohols and ketones.
- Chemical Raw Materials, which include ethylene and butadiene.

Escon polypropylene plastic, one of the newer "miracle plastics," was introduced a little more than a year ago when Humble opened its polyolefin plant at Baytown, Texas. A plastic that retains its basic shape in temperatures up to 290 degrees Fahrenheit, Escon can be made into molded products, film, sheets of plastic or strands of fiber. This petroleum-based plastic is extruded in a spaghetti-fashion, chopped into small pellets, packaged in bags or drums, and marketed to the manufacturers of plastic products.

Polypropylene, like most of the Enjay line, is an intermediate product — a chemical that is supplied to industrial users, who, in turn, convert them into a thousand and one consumer items.



➤ A PARTIAL *view of the new plant at Humble Oil & Refining Company's Baytown Refinery, which has started commercial production of polypropylene, a versatile new plastic that can be used in molded products, film, monofilaments, sheeting and fibers.*

To keep supplies of its products readily available for delivery to industry in all regions of the United States, Enjay maintains a network of package warehouses and bulk terminals in more than 35 cities. These supplies are closely correlated to the needs of the company's customers by Enjay's 11 sales offices, which are located in key marketing areas of the country.

Administering Enjay's expanding chemical operations are: J. E. Wood, III, president since 1958; R. K. Dix, A. D. Green, and K. J. Nelson, vice presidents. Mr. Dix concerns himself with Product Management, Mr. Green heads the New Projects Department, and Mr. Nelson is in charge of Sales.

General headquarters for the Enjay Chemical Company is in New York

City, with division offices in New York, Chicago and Houston, Texas. A substantial portion of Enjay's product sales are to an affiliated company, which markets chemicals around the world.

The growing stream of Enjay products — now including some 50 petrochemicals — flows from four Humble refineries. Two of these plants are located in the Gulf Coast area at Baytown, Texas, and Baton Rouge, Louisiana; the others are on the Atlantic Coast at Linden (Bayway) and Bayonne, New Jersey.

Backing up the Sales Department's nation-wide organization is the Enjay Laboratories at Linden, probably the most modern and complete customer-sales service laboratories in the petrochemical industry. At the laboratories, a staff of more than 100 research scientists and skilled assistants devote their full time and talents to helping Enjay's customers develop new products from petrochemicals and to improving the quality of existing products. Recently, Enjay added a new 30,000-square-foot wing to the labs for the sole purpose of providing technical service work on plastics. This wing contains essentially all available types of plastics-fabricating equipment.

Research and market development have helped spark the company's rapid growth in a growing industry. Each member of the organization — from President Wood to the salesman in the field — knows he is backed by a research staff that has helped develop dozens of useful products, and is working toward the introduction of many others.

➤ HOT POLYPROPYLENE — *This new petroleum-based plastic, resembling strings of spaghetti as it flows from the extruder unit, is cooled and chopped into small pellets for packaging and shipment to product manufacturers.*

And each new product, as it comes along, adds to the promise of a bright future for the petrochemicals industry.

Only recently, a company official looked toward this future and said:

"The future for petrochemicals looks bright. Scientists estimate that more than 500,000 useful organic chemical compounds can eventually be made from petroleum hydrocarbons. The present demand for petrochemicals is increasing at a thumping 10 per cent a year, and we fully expect this pace to continue for some time to come."

Dumping Radioactive Wastes

➤ RADIOACTIVE wastes can be safely disposed of by dumping them in wells drilled deep into the ocean bottom.

A huge ship, especially designed for storing radioactive waste, would be used to drill wide holes in deep ocean submarine canyons, Prof. John D. Isaacs of the Scripps Institution of Oceanography, La Jolla, Calif., said recently. The waste material would be lowered into the hole and buried.

Buried under tons of sediment far from heavily populated areas, the radioactive wastes would pose no health problems, Prof. Isaacs said. The radioactive heat generated while contained in the ocean bottom layers will not erupt into a "radioactive geyser," whereas atomic wastes stored in underground vats on land can, the scientist emphasized.

The huge ship, acting as an "atomic disposal unit," could cruise from port to port, picking up the "atomic trash." The ship's design would be similar to CUSS I, a ship recently used for drilling deep into the earth's interior.

Such a drilling ship is entirely feasible, the scientist said. U. S. scientists recently drilled three test holes into the ocean bottom in one day as part of project Mohole, whose goal is to eventually reach the earth's mantle deep under the ocean bottom.

Each were sufficiently deep to bury the radioactive wastes, Prof. Isaacs said.

The wastes can be stored in capsules or mixed with concrete slurry and pumped into the hole. The slurry, or watery mixture, would then solidify when it reached bottom.

The present method of storing radioactive matter in huge underground tanks could eventually contaminate underground water supplies. Dumping waste matter into ocean waters, and not underneath the ocean bottom layers, is also dangerous due to the eroding and mixing action of currents.

On the Back Cover

➤ THE BACK COVER *shows Suntide Refining Co's new 30-million-lb-year ethylbenzene plant. It uses a separation and recovery process developed by Cosden and Badger, and is now in operation at the Suntide refinery in Corpus Christi, Texas. The new unit, designed, engineered, constructed and placed on stream by Badger Manufacturing Company, Cambridge, Massachusetts, in seven months, recovers high-purity ethylbenzene from a mixed xylene stream in a single step.*

The electronically-controlled unit is located in a plot area measuring 120 feet by 160 feet, which necessitated "tight" working arranegments. Tall towers — over 200 feet high — characteristic of plants of this type, were shipped in one piece, and erected with insulation and internals in place. The towers share a common foundation consisting of 400 cubic yards of concrete.

Book Condensations

MODERN MATERIALS: Advances in Development and Applications, Vol. 2 — Henry H. Hauser, Ed. — *Academic*, 413 p., illus., $12.50. On polymer modified papers, ceramics for cutting purposes, borides, titanium metallurgy and welding materials.

ESSENTIALS OF CHEMISTRY IN THE LABORATORY — Harper W. Frantz and Lloyd E. Malm — *Freeman*, 308 p., illus. by Roger Hayward, paper, $3.30. Teachers edition with instruction manual.

TECHNIQUES IN FLAME PHOTOMETRIC ANALYSIS — N. S. Poluektov, transl. from Russian by C. Nigel Turton and Tatiana I. Turton — *Consultants*, 219 p., illus., $9.50. Discussion of bases of methods, apparatus, photometric measurement procedure, and techniques for determining elements in various materials.

PLASTICS TOOLING — Malcolm W. Riley — *Reinhold*, 2nd ed., 216 p., illus., $7.50. Revised guide to the properties and fabrication methods of plastics as they apply to tooling.

CERAMICS — P. William Lee — *Reinhold*, 210 p., illus., $5.95. Survey of the applications of ceramic materials in industry, including their history, raw materials and basic chemistry.

STANDARD METHODS OF CLINICAL CHEMISTRY, Vol. 3 — David Seligson, Ed. — *Academic*, 230 p., illus., $6.50. Covers wide variety of methods, from alcohol determinations in biological materials to transaminase.

SPECIAL CERAMICS: Proceedings of a Symposium held at the British Ceramic Research Association — P. Popper, Ed. — *Academic*, 369 p., illus., $10.50. Reports on progress in the study of new dielectric materials, mainly of the non-oxide type.

INTRODUCTION TO PHYSICAL AND PATHOLOGICAL CHEMISTRY — L. Earle Arnow, rev. with Marie S. D'Andrea Logan — *Mosby*, 6th ed., 490 p., illus., $5.50. Updated textbook on the science of chemistry as it applies to nursing, with greatly expanded section on organic chemistry.

THE METALLURGY OF SEMICONDUCTORS — Yu M. Shashkov, transl. from Russian by J. E. S. Bradley — *Consultants*, 183 p., illus., $9.50. Surveys in detail the semiconductor metallurgy of germanium and silicon.

THE CHEMISTRY OF NUCLEIC ACIDS — D. O. Jordan — *Butterworths*, 358 p., illus., $10.50. Comprehensive treatment of the chemistry and structure of nucleic acids.

ELECTROLYTIC DISSOCIATION — C. B. Monk — *Academic*, 320 p., $10. Intermediate level treatment, paying most attention to the properties of electrolytes mostly concerned in the study of their dissociation in solution.

RARE METALS HANDBOOK — Clifford A. Hampel, Ed. — *Reinhold*, 2nd ed., 715 p., illus., $20. Fully revised, now includes cesium, chromium, plutonium, rubidium, scandium and yttrium. Arranged for speedy reference.

Chemistry Comments

Interesting facts in the chemical world.

➤ As early as 940 B.C. the Chinese had discovered and harnessed natural gas.

➤ During the last half century a total of 1, 027, 332 whales have been killed, yielding 70,180,796 barrels of oil.

➤ Salt mining was the first industry to use natural gas as fuel.

➤ Super-sensitive films have opened the door to almost universal use of photographic instrumentation for intricate research under difficult conditions.

➤ Helium exists in only insignificant concentration in the earth's atmosphere, but its concentration in the sun is believed to be about one-tenth as much as hydrogen.

➤ It takes 115 gallons of water to grow enough wheat to make a loaf of bread.

➤ Approximately $19,900,000 will be expended in fiscal year 1962 in a new research program adopted by the Atomic Energy Commission for high-temperature materials and high-performance reactors.

➤ About 300 billion gallons of water are being used each day in the U. S.

➤ The earth has a tail like a comet and the counterglow, observable at night during certain periods, is a view of the illuminated end of the tail.

➤ The decimal inch scale, which achieved national status for the first time in 1957, was used as far back as 1792 by Benjamin Franklin when he designed his famous Franklin stove.

➤ Color, which is one of the most important factors in the grading of tomatoes, can now be measured accurately by a new electronic colorimeter.

➤ Lead wire incorporated in drapery fabric produces an attractive sound curtain that provides about the same acoustical isolation as a cinderblock wall.

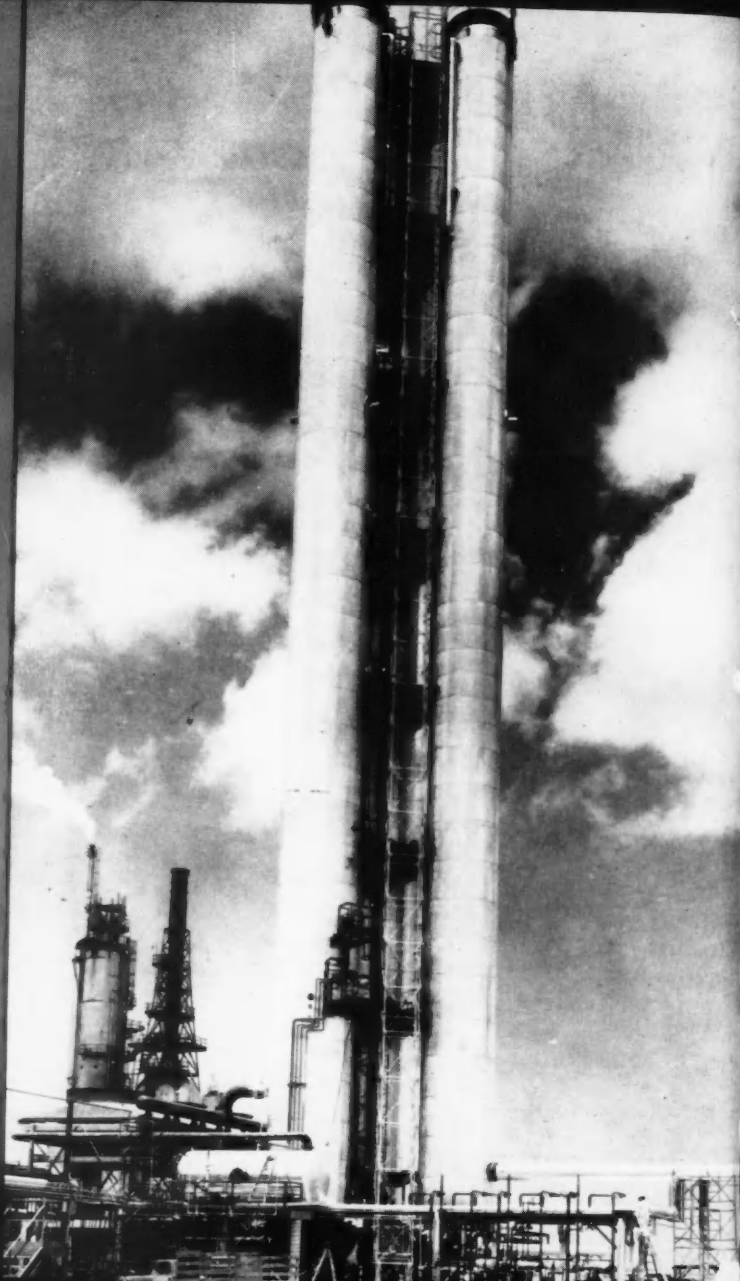
➤ Piezoelectrics are materials that develop an electrical voltage when stressed, and are now being used to produce an ignition system with a "spark pump" the size of a candy bar.

➤ Acids from mines kill fish by stopping blood circulating through the gills.

➤ Well fertilized pasture grasses may be as high as 28% to 30% in protein in April and then decline to 4% to 7% in July and August.

➤ The first U. S. astronaut broadcast from outer space to earth was powered by two small electron tubes about the thickness of a pencil.

➤ Research has shown that it may be possible to store radioactive waste materials by converting them into insoluble glass-like solids.



OCTO
19

Thirty-
Ye